

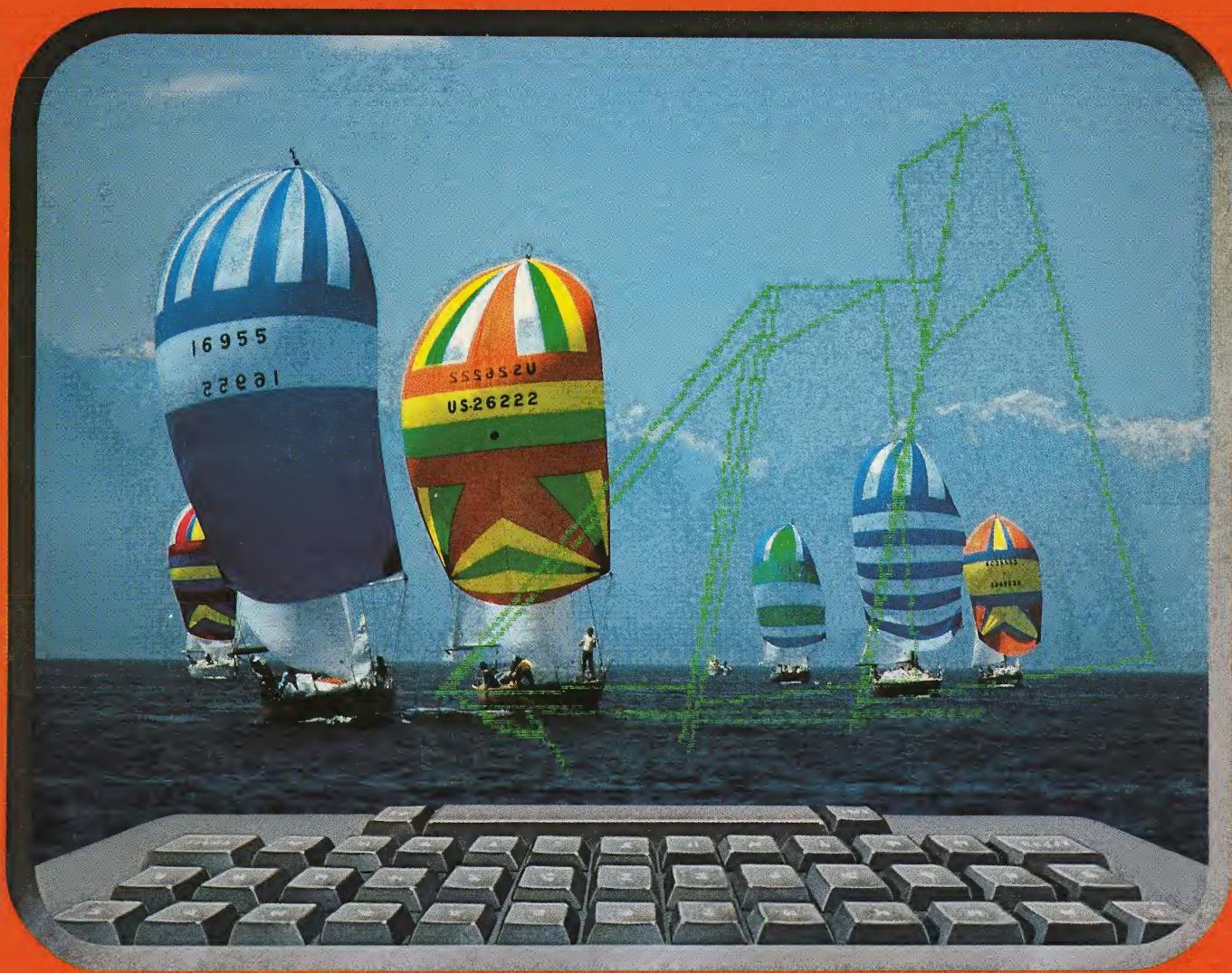
NO. 49

JUNE 1982

U.S./Canada Edition: \$2.50  
International Edition: \$2.95  
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# ACRO

THE 6502/6809 JOURNAL



## Applications Feature

Low-Cost Digitizer for Apple

Face Synthesizer for PET

Microcomputer Interfacing: FORTH vs. BASIC

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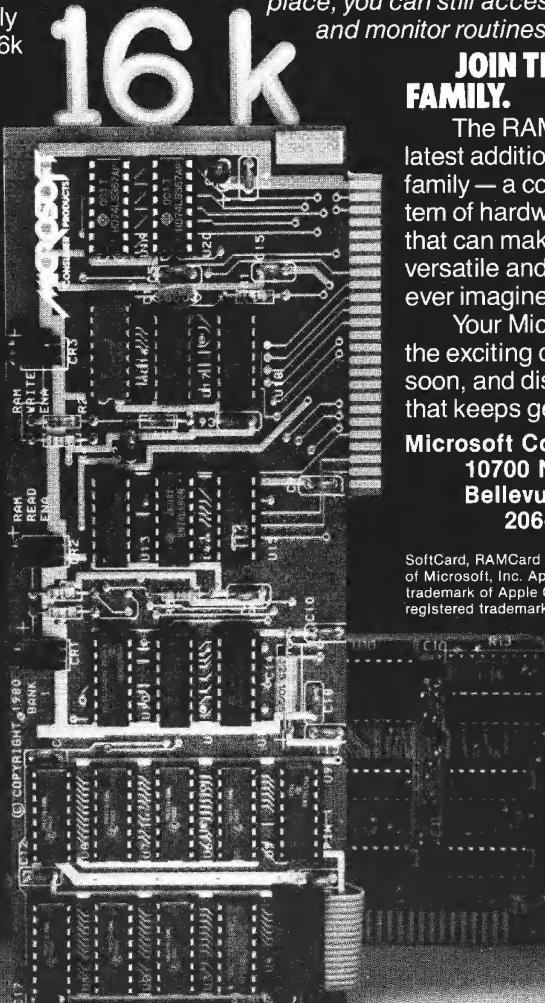
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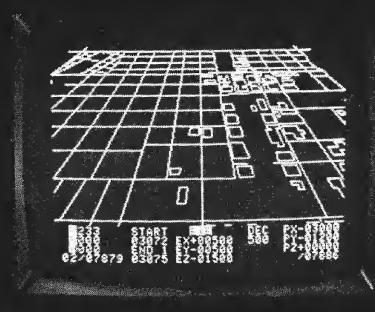
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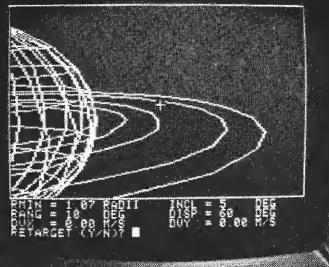
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## A2-3D1

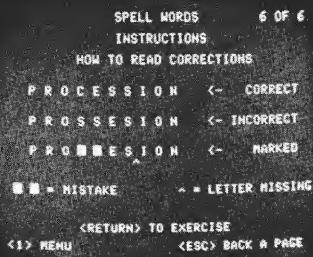
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Q. Do you have difficulty operating your printer when connected to a time-sharing computer? Are files you're trying to download too large for your system buffer? Does your host computer lose data when you send files to it?

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## Authors

Q. Does your line of work involve sending written material to others? Are you a program author who would like to send work in progress to a partner or client and know that it arrived intact? What would the ability to instantly send material or programs to anyone at any time be worth to you?

A. "The Professionals" provide the ideal way to send your articles, manuscripts, reports, programs and technical documents to another computer with phone line access. Now you can work WHEREVER you want, and be assured that your data is sent to its destination quickly and error-free. In fact, compared to the fastest mail services, "The Professionals" offer immediate delivery and will save you the purchase price in just a few uses.

## Students

Q. Are you bothered by limited access to your school's existing terminals? Would you like to be able to do your school assignments at home at your own convenience?

A. "The Professionals" allow you to access virtually any dial-up school or college computer system over standard telephone lines. This means no more waiting in line for an available terminal or hassles with malfunctioning school equipment. You can even prepare term papers or reports while off-line and send the completed work to the school computer for final printing. Best of all, you can work from home at the times most convenient for you.

## Time Share Users

Q. Are you tired of wasting time and money sending or receiving files with inadequate, poorly designed software? Do you find yourself manually performing the same lengthy log-in procedures over and over again? Would you like to automate these procedures for yourself and others?

A. "The Professionals" allow you to send files which have been prepared in advance. They may then be transferred at any time, as quickly as possible — even to several different systems. No time is wasted reviewing information while on line; data may be captured by your computer or printer (or both) to be evaluated later at your convenience. These features assure minimum on-line time and therefore minimum on-line cost.

"The Professionals" introduce macros that are more sophisticated than anything previously seen in communications software. These "hand-shaking" macros allow you to perform complete multi-stage log-on sequences automatically; all you do is specify the system to be called. This eliminates sign-on errors and greatly simplifies operation of the entire system, not only for you, but for other less skilled operators.

## Bulletin Boards

Q. Would you like to be able to take advantage of the information featured on local bulletin boards and information services such as The Source, CompuServe, Dow Jones, and others?

A. "The Professionals" open the world of modem communication networks to you. There are already thousands of these systems and networks in use nationwide. "The Professionals" provide an ideal way of accessing these systems. All 80 column boards, external terminals (even the 40 column screen), and currently available communications devices are fully supported, including the Hayes Micromodem II and Novation Apple CAT. All standard baud rates — 110, 300, 1200 and others — are fully supported; BAUDOT too, if your computer is equipped with the Apple CAT modem.

## Clubs

Q. Are there other Apple owners with whom you would like to exchange programs or files, but have been unable to do so because of limitations imposed by the software you now use?

A. Any two Apples equipped with "The Professionals" can transfer ANY type or size file with complete error checking and correction. All of "The Professional" packages are fully conversant with each other and operate almost identically. For the first time ever, you can transfer compatible files to an operating system different from yours — error free!

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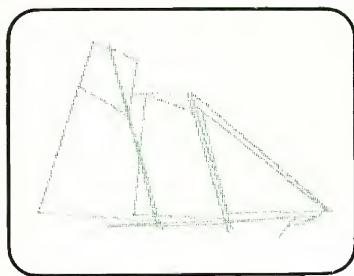
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## About the Cover



The yachts on our cover this month are sailing off British Columbia in the race for the World Championship. Advanced graphics capabilities make computers an excellent tool for sail designers, allowing them to simulate the performance of a proposed design and make adjustments that optimize performance.

Our cover graphic shows the sail and spar plan of the yacht *America*, which won the Royal Yacht Squadron Cup from the British in 1851. The *America*'s design stunned the yachting world of the time and completely outclassed the competition. Computers have since increased the pace of creative innovation.

Cover photo: Brian Dowley Photography  
26 Peverell St.  
Dorchester, MA 02125  
617/288-1530

# MICRO™

## Editorial

It was exactly one year ago that MICRO ceased to be exclusively about the 6502 microprocessor and its large family of products. I wrote a four-part series entitled "It's Time to Stop Dreaming," which examined the new 6809 microprocessor from the point of view of a 6502 devotee. Since then I have become personally much more involved with the 6809, by choice, and the 6809 world has expanded and matured in many ways.

On the personal side, MICRO is just one of my activities. I also have a company, The Computerist, Inc., which for many years has been actively developing, manufacturing, and selling products for the 6502, especially expansion boards for the AIM, SYM, and KIM microcomputers. About the time we decided to cover the 6809 in MICRO, we had also decided to have a 6809 as an option on our new Flexi Plus multi-purpose expansion board which was in the final stages of development. Well, the 'option' turned out to be the most significant part of the new product, and since last June I have been very actively involved with the 6809. I am no longer the 6809 'novice' I was then. I strongly urge all programming-oriented readers to become acquainted with this device. It has many features which make it a dream to use.

Of greater significance to the MICRO reader is the 6502/6809 explosion. There are several strong points at which the 6502 and 6809 interact. There are now at least two companies making devices to plug into your Apple II to permit it to run a 6809: The Mill by Stellation II and the Excel-9 by ESD Labs. Both processors are standard equipment for the Commodore SuperPET. The Computerist FOCUS system can run with either processor. And the Synertek SYM-1 has a simple 6809 conversion board.

But, exciting as some of these products are, the real significance lies in the software. Almost every 6809 system made will run either the Technical Systems Consultants' FLEX, or the Microware Systems Corporation's OS-9, or both. These two operating systems provide the 'glue' which holds

the 6809 world together. Unlike the 6502 world which developed a totally different operating system for each product, the 6809 world has generally accepted these two systems as the starting point for development. The Mill already offers OS-9 and the Excel-9 runs FLEX. Versions of these are available now (or very soon) for the TRS Color Computer. The result is that there is a large population of software which will run on virtually any 6809 system. If you are a purchaser of software, this means that there are more high quality packages available than would be the case if each machine were different. If you are a developer of software for sale, imagine your new product having this diverse population of computers and users as a market.

If you become convinced that it is worth upgrading your existing equipment or even investing in a total 6809-based system, what about all of the software you have already written in 6502 assembler? At least one company, Frank Hogg Laboratory, is already offering a program to translate 6502 code into 6809 code, and others will probably follow. Once you have your 6809 going, if you ever require 6502 code again, there are several 6809-based cross assemblers available which will support the 6502.

If you have written the bulk of your software in BASIC, Pascal, FORTH, COBOL, or C, then life is even easier. All of these languages are fully supported in the 6809 world, and generally in more sophisticated packages than their 6502 brethren (reflecting in part on the superiority of the 6809 in writing position-independent code, using multiple stacks, 16-bit index registers, and so forth).

I believe that inherent superiorities of the 6809, the systematic development of the general operating systems, and the overall quality of the hardware and software that is being offered will make the 6809 a very significant device in your microcomputing future — whether you buy one or not! Therefore, MICRO will continue to provide you substantial information about the 6809 and the family of products which are developing around it.

*Robert M. Gross*

**MICRO™** is published monthly by:  
MICRO INK, Inc., Chelmsford, MA 01824  
Second Class postage paid at:  
Chelmsford, MA 01824 and additional  
mailing offices  
USPS Publication Number: 483470  
ISSN: 0271-9002

Send subscriptions, change of address, USPS Form 3579, requests for back issues and all other fulfillment questions to

MICRO  
34 Chelmsford Street  
P.O. Box 6502  
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<i>Subscription Rates</i>	<i>Per Year</i>
U.S.	\$24.00
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Foreign surface mail	\$27.00
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# MICRO™

## New Publications

Mike Rowe  
New Publications  
34 Chelmsford Street  
P.O. Box 6502  
Chelmsford, MA 01824

**Word Processors and Information Processing**, by Dan Poynter. Para Publishing (P.O. Box 4232, Santa Barbara, CA 93103), 1982, 172 pages, 5½ x 8½ inches, paperback.  
ISBN 0-915516-31-4

\$11.95

This book is designed to aid you in purchasing equipment, products, and services. It will help you determine what your word processing requirements are. Includes a product directory and a resource section.

**CONTENTS:** The Word Processing Dilemma; What Is Word Processing And How Can It Help Me?; The Parts of the Word Processor: The Choices; Word Processor Functions and Features; Let The Buyer Compare

How To Buy A Word Processor; The Price and Other Costs; Appendix: For More Information; Glossary Of Word Processing Terms; Index; Colophon.

**BASIC Programs for Scientists and Engineers**, by Alan R. Miller. Sybex (2344 Sixth Street, Berkeley, CA 94710), 1981, 318 pages, 7 x 9 inches, paperback.  
ISBN: 089588-073-3

\$14.95

A library of BASIC programs encountered in science and engineering applications. Each program is explained in detail.

**CONTENTS:** Preface; Introduction; A Note on Typography; Evaluation of a BASIC Interpreter or Compiler; Mean and Standard Deviation; Vector and Matrix Operations; Simultaneous Solution of Linear Equations; Development of a Curve-Fitting Program; Sorting; General Least-Squares Curve Fitting; Solution of Equations by Newton's Method; Numerical Integration; Nonlinear Curve-Fitting Equations; Advanced Applications: The Normal Curve, the Gaussian Error Function, The Gamma Function, and the Bessel Function; Appendix A: Reserved Words and Functions; Appendix B: Summary of BASIC; Bibliography; Index.

**From Chips to Systems: An Introduction to Microprocessors**, by Rodney Zaks. Sybex (2344 Sixth Street, Berkeley, CA 94710), 1981, 551 pages, 7 x 9 inches, paperback.  
ISBN: 0-89588-063

\$14.95

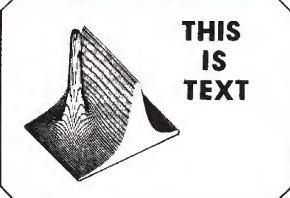
A history of microprocessors, including a discussion of its support components and design. No preliminary knowledge of microprocessors needed.

**CONTENTS:** Preface; Introduction; Fundamental Concepts; Internal Operation of a Microprocessor; System Components; Comparative Microprocessor Evaluation; System Interconnect; Microprocessor Applications; Interfacing Techniques; Microprocessor Programming; Assembly and High-Level Programming; System Development; The Future; Appendices; Index.

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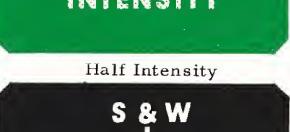
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- The Double Density High Resolution Graphics. Yes, you can plot 560 dots in one line. You have only 280 dots in one line on ordinary Apple-II. (Software is required)
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**HIGHLIGHT** 

**HIGHLIGHT** 

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# Silicon Office: A Review

by Jim Strasma

*Editor's Note: Because of the size, complexity, and significance of "Silicon Office," we feel it cannot be covered adequately in our normal "Reviews in Brief" format.*

Product Name: **Silicon Office**  
Equip. req'd: CBM 8096 and  
8000 or higher  
series CBM disk  
drive. IEEE modem  
and CBM or ASCII  
printer optional.  
Price: \$999.00  
Manufacturer: Bristol Software  
Factory  
P.O. Box 14  
Horley, Surrey  
England

*Silicon Office* is the most significant program yet written for any microcomputer. It claims to handle the daily computer needs of a small business with a single program, and very nearly does! Nothing remotely comparable is available on competing microcomputers. It may well become the Software Sensation of 1982, and a vast boost to Commodore sales. Already it is outselling all other business programs in Europe, where it has been available for six months. This is in spite of a price tag there of \$1,600.

What is so special about *Silicon Office*? For one thing, it's the largest single machine-language program ever written for a microcomputer. It occupies 54K bytes, representing 27000 lines of source code. (Triple the size of VisiCalc.) In return for taking nearly all available memory space, *Silicon Office* gives complete freedom in using both drives of the disk unit.

Briefly, *Silicon Office* does three things: 1) it is a database language — the only one available on a microcomputer; 2) it is a word processor — one with amazingly useful features; 3) it is a communicating terminal. It is this multi-functionality which makes it worth nearly any price. Compared to the cost of say, *Jinsam 8.2*, plus *Word Pro 4 Plus*, and some sort of terminal program, it is a bargain.

Gestalt psychotherapists teach that the whole is greater than the sum of its parts. This is certainly true of *Silicon Office*. It is vastly more useful than having three separate programs with similar functions. Each of its modes interacts with the others in very useful ways. For instance, the report generator is the weakest link in most database packages I have used. In *Silicon Office*, the report generator is the word processor, which has full access to the entire database at all times.

The first function of *Silicon Office* is database management. In this role, it is visibly the replacement for *OZZ*, the company's previously best-known program. (*OZZ* is probably best known for its role in helping rescuers during the MGM Grand Hotel fire. It was used there to keep track of thousands of guests.) *OZZ* had its faults, primary among them limited record and file size, single sort key, and fragile non-standard file structure.

*Silicon Office* has overcome these weaknesses. It uses standard Commodore relative files for data, and opens and closes the disk file each time a record is read. This makes it nearly impossible to lose the entire file. To get around the file size limitations of Commodore's relative records and the 8050 disk unit, *Silicon Office* allows each record to consist of up to six separate relative records, allowing an effective record size of 6\*252 characters.

Most users, however, won't need records that large, due to the program's ability to link up to six totally independent files in meaningful ways. It is what is called a Relational Database. This makes it arguably the only true database manager for Commodore computers. To my knowledge, only *MDBS* and *DBase II* for the S-100 market, and *DB Master* for the Apple share this capability.

Why do you need a relational database? Let me share an example from my work. As pastor of a 370-member church, I have 300 families to track, each with one to nine members. I have

tried over 20 database packages, and every one required total duplication of all information on each family in the records of each family member. They further required that every record have exactly the same fields as every other record. This makes no sense for a church. A weekly record of attendance and contributions isn't needed for a student a thousand miles from home. And it is a horrible waste of time and disk space to copy the same street address into the records of ma, pa, and each of six kids. Imagine the fun when they move across town....

A relational database gets around this problem by defining different kinds of records for different situations, and allowing them to be used together. With *Silicon Office*, I now have three basic record formats: one for each local family, a second for each active member, and a third for distant families.

Each family record contains a reference to the matching individual records, and vice versa. Likewise, the distant records include a number that allows them to be merged in with the family records for all-church mailings. To expand the concept further, I could add a further distinction between adult and child records. Redundant information, such as the town name is supplied from a separate, disk-storable, variable memory with *Silicon Office*.

File structures are easy to design, by drawing them on the video screen. Commodore-recommended forms editing standards are followed. Unlike competing programs, *Silicon Office* allows range checks and validation on each field, and can be designed to allow or prevent duplicate field data in a file's primary sort key.

Like at least one competing package, CMD's *The Manager*, it also has arithmetic functions, although more of them and far better handled than in its competitor. Among these, the most interesting is DATE, which includes the ability to calculate days between dates, and already knows that 1982 isn't a Leap Year. But *Silicon Office* goes one

crucial step further, a step that makes it truly a new language. It allows branching, the all-important IF statement. (It is only the lack of this, in my opinion, which keeps VisiCalc from being a language.) *Silicon Office* allows up to a hundred database commands, including IF and GOTO, to be pre-programmed in a simple English-like syntax. These commands can be saved as a file, and also linked to almost any effective program length.

As if that weren't enough, *Silicon Office* also includes true variables, 64 numeric and 26 string. They may have names of up to 16 significant characters, and numeric precision of 14 digits. It is even possible to program in user input prompts for untrained operators. The responses can be stored as variables.

Some of *Silicon Office*'s other database features are: the ability to have tables in memory for data lookup; subsorting from one field to another when matches are found while sorting; the ability to automatically create records for a new file from the record data of other files; searches for records with field data within preset bounds; and wild-card searches for arbitrary strings of characters, either within particular data fields or throughout the entire file. This last feature proceeds at the previously unheard-of (in Commodore circles at any rate) speed of 250 full-length records per minute.

Perhaps by now you have forgotten that this package also includes a word processor? Don't! It is not just another word processor. This one extends the state of the art, very obviously building on the better features of its competitors *Word Pro 4 Plus* and *Wordcraft 80*.

One of my chief complaints about previously available word processors has been the difficulty (or impossibility) of linking text files too large to fit in memory at once. I can't use recent versions of *Word Pro*, for example, to write sermons, simply because they aren't able to hold the full text of a 20-minute message at once, and linking is too much trouble. But in *Silicon Office*, the entire disk may be treated as part of the text area. You pass from one file to another, up to a maximum of 150-180 printed pages, by simply scanning from "page" to "page" of memory. There is sufficient buffering of text that the disk access time is not noticeable.

Like *Wordcraft 80*, *Silicon Office* is based on the idea that "What you see is what you get." Formatted output can be wider than the standard 80-column

screen up to a maximum of 125 columns; both include horizontal scrolling like that in VisiCalc. Text is formatted immediately on the screen. However, unlike *Wordcraft 80*, this formatting is done immediately. There is no chance for the typist to get ahead of the word processor, or to have to wait until what was just typed appears on the screen. Inserts and deletes are done at full-speed. Whole chapters may be quickly inserted in the middle of existing text files.

Like the other programs mentioned, *Silicon Office* justifies text. However, it justifies *within* words, not merely between them as on the others, leading to an extremely smooth appearance of finished text. Even more important, it is easily able to handle true multi-column documents, in a single pass through the printer. This makes it the only Commodore-compatible word processor suitable for newsletter formatting. Naturally, it also works well with nearly any ASCII daisy wheel printer, and can send any needed ASCII sequence.

Another amazing feature of *Silicon Office* (that has people in Europe trading in dedicated word processors) is its ability to perform truly complex calculations of text data and format the results, *at print time*. And we haven't forgotten about the database manager, have we? The word processor can use any variable or field data anywhere in the currently accessible data files. It can even pause while changing data diskettes. And if the printer fouls up, it can restart from the top of any page.

Both the data manager and the word processor handle "find" and "change" tasks more intelligently than competing programs. Matches are made without regard to the case, upper or lower, of the text being searched. But if a change is made, the new text is made to conform to the case of the replaced text, even in words containing both upper and lower case text.

The communications capability requires a *Silicon Office* at both ends of the line. But within that limitation, it is possible to do almost anything from a remote terminal that could be done locally, including sending every kind of file used by *Silicon Office*.

Officially it is for the Commodore 4010 modem, which is now hard to get. However, any RS232 modem should work, if connected to the IEEE-488 port via a bi-directional interface, such as the TNW 2000.

The sellers are obviously making great efforts at support. Already available is an application library that includes the equivalent of five megabytes of data file examples, including: inventory, payroll, general ledger, job control, and so on. There is also a support Hotline, a newsletter of user applications, and a videocassette training course. There is also, thankfully, a two year guarantee on the program, including needed upgrades for such predicted events as Commodore's forthcoming DOS 3.0 and hard disks. And the manuals are just perfect. The training guide teaches all the essentials in one or two hours, and the HELP screens within the program reference a complete and well-organized reference manual. There is also a complete programmer's reference section on file structures, telling how to access them from other programs.

What don't I like about *Silicon Office*? I can sum it up in one word — protection. With 4½ man years of programming effort in the program, I certainly appreciate why the Bristol Software Factory doesn't want the user giving away their program. However, they only supply one spare diskette, and have gone to great pains to be sure no one copies it. Thus, if I trash a diskette, I'll have to be extra careful with the spare for the week or so it takes to mail in the dead diskette and get back a replacement. Also, I can't make any changes to handle special needs.

Having watched the throes of foreign DOS disk protection on the Apple II for the past two years, I don't welcome this first appearance of it on the Commodore disk drives. Fortunately, once *Silicon Office* is loaded, its diskette may be safely filed away until the next day (assuming nothing resets the computer meanwhile.) On that basis, with normal care, a diskette should last a long time.

Since I'm quibbling, I may as well mention that data files are stored in screen codes and need conversion for use in other programs. Fortunately, the needed fixes are included in the manual.

Do I recommend *Silicon Office*? You'd better believe I do! It is the single best program I have ever seen!

For more information contact Associated Marketing Systems, Inc., 55 Central Dr., Farmingdale, NY 11735.

MICRO

# Disk to Tape Backup Utility

by Richard Merten

**In this article the author demonstrates ways to save money on archives by using cassette tape to back up and restore every sector of a disk.**

## Disk to Tape requires:

Apple II or Apple II Plus  
48K, DOS 3.2 or 3.3  
Integer BASIC in language  
card or motherboard

This program for making backup tapes is easy to use and will run with either 13- or 16-sector diskettes. It is short — less than one page of machine language and about 50 lines of Integer BASIC. It also contains error checking routines that alert you to problems from both the disk and the cassette. An entire 16-sector disk can be sent to tape in about 15 minutes. As many as four full disks can be stored on a single C-60 cassette, or six on a C-90.

To transfer a disk to cassette, first run the Backup program from a diskette using the same DOS as the disk that you are going to duplicate. (This is important because the backup program uses the RWTS routines in the Apple to read and write information to the disk.)

The BASIC portion loads the machine language routine then asks if you want to save or restore a disk. For two-drive systems you can put the disk in either drive 1 or 2, then turn on the tape recorder and press return. If you are saving a DOS 3.3 disk no problems should occur, but if you are saving a DOS 3.2 disk to tape, there will probably be at least two sectors on track 2 that cannot be read.

If a sector cannot be read, the track and sector that DOS is unable to read will be printed to the screen. These unreadable sectors are filled with zeros before they are sent to the tape. This

## Listing 1

```
10 REM  BACKUP DISK TO TAPE UTILITY
20 REM          BY
30 REM          R.C. MERTEN
40 REM
50 REM          7/18/81
60 REM
70 LOMEM:24576
80 D$=""; REM CONTROL D
90 PRINT D$;"BLOAD TAPBAK.OBJ"
100 REM  GET ADDRESS OF SECTOR NUMBER AND LENGTH FROM MACHINE LANGUAGE
110 TOTAPE=256* PEEK (2049)+ PEEK (2048); FRMTAPE=256* PEEK (2051)+ PEEK
(2050)
120 SECLEN=256* PEEK (2053)+ PEEK (2052); SECNUM=256* PEEK (2055)+ PEEK
(2054)
130 REM  PEEK AT WHICH VERSION DOS (IN 48K MACHINE)
140 DOS= PEEK (-19522); IF DOS=3 OR DOS=2 THEN 160
150 CALL -936; VTAB 13: PRINT "ERROR!! EITHER NOT A 48K MACHINE OR PAGE3
HAS BEEN ALTERED"; PRINT : PRINT "REBOOT DOS AND TRY AGAIN"; END
160 IF DOS=3 THEN 190
170 REM  IF DOS VERSION 3.2 POKE IN NEW SECTOR NUMBER AND SECTOR LENGTH
180 POKE SECNUM+1,12; POKE SECLEN+1,80
190 DRIVE=2; TRACK=3; ERR=6; DIM A$(10)
200 CALL -936; VTAB 4: PRINT "          DISK TO TAPE BACKUP UTILITY"
210 PRINT : PRINT "          BY R.C. MERTEN"
220 PRINT : PRINT "          FOR DOS 3.;"!DOS
230 VTAB 14: PRINT "THIS UTILITY WILL SAVE OR RESTORE AN"; PRINT : PRINT
"ENTIRE DISK TO TAPE, DOS AND ALL!"
240 VTAB 20
250 PRINT : PRINT "IT TAKES ABOUT 15 MINUTES TO COMPLETE"; PRINT : PRINT
"PRESS RETURN TO CONTINUE"
260 INPUT "",A$
270 CALL -936
280 VTAB 3: PRINT "          DOS 3."!DOS;" TAPE BACKUP UTILITY "
290 VTAB 6: PRINT "          1) SAVE TO TAPE"
300 PRINT : PRINT "          2) RESTORE TO DISK"
310 PRINT : PRINT : INPUT "          WHICH .W"
320 IF W<1 OR W>2 THEN 270
330 VTAB 11: INPUT "          ENTER DRIVE # (1 OR 2) ",DR; IF DR<1 OR DR>
2 THEN 330
340 POKE DRIVE,DR
350 VTAB 16: PRINT "PUT DISK IN DRIVE #";DR;" START TAPE RECORDER";PRINT
"AND PRESS RETURN"
360 INPUT "",A$
370 VTAB 15: CALL -958
380 IF W=2 THEN 510
390 ERRT=0
400 FOR X=0 TO 34 STEP 5: VTAB 13: PRINT "          NOW BACKING UP TRACKS "
410 :X;" TO ";X+4
410 POKE TRACK,X
420 CALL -958
430 VTAB 15: TAB 9
440 POKE 50,63: PRINT "BAD TRACK & SECTOR LIST"; POKE 50,255
450 PRINT "T$      S$"
460 CALL TOTAPE
470 ERRT=ERRT+ PEEK (ERR); NEXT X
480 PRINT : PRINT "          ";ERR;" ERRORS! WANT TO BACKUP ANOTHER?"
490 INPUT "",A$: IF A$="Y" THEN 270
500 END
510 FOR X=0 TO 34 STEP 5: VTAB 15: PRINT "          NOW RESTORING TRACKS "
520 :X;" TO ";X+4
520 POKE TRACK,X
530 CALL FRMTAPE
540 IF PEEK (ERR)=0 THEN NEXT X
550 IF PEEK (ERR)=128 THEN GOTO 590
```

(Continued)

presents no problem when the disk is reconstructed since they are not used during the booting process.

A read error from the disk will cause an error indication to appear on the screen. However, a read error from cassette is considered fatal and causes the program to bomb gracefully, asking if you would like to try again.

## How it Works

Information is moved from tape to disk and back again five tracks at a time, a total of seven times through the loop to accommodate all 35 tracks. The program keeps you posted on its progress with beeps and other updates along the way, and totals any errors at the end.

The BASIC portion of the program is primarily concerned with prompting the user, and general housekeeping activities. The assembly language portion does most of the work, so the detailed explanation will start there.

Two CALLS are possible from BASIC. A series of subroutines called TOTAPE moves information from disk to tape. Another series called FRMTAPE moves data from the cassette onto the disk. In either case the 6502 registers are first saved for the return trip to BASIC. Next, the page zero addresses starting at \$10 are moved into a temporary buffer starting at \$910. This is done because the RWTS routine changes page zero data that makes it impossible to correctly return to the BASIC caller.

Next the location of the DOS IOB routine is located with a JSR to location \$3E3. On return the IOB address is in the accumulator and Y registers. This address is saved at IOBADD and used to index information in and out of the IOB.

After some registers have been set up, the program loops through the GETRAX and NXTRAK routines until five full tracks have been read into (or written out of) a buffer area that begins at \$1000. If at any time the processor returns from the RWTS routine with its carry flag set, it will then jump to the ERROR routine. After all five tracks have been moved, the page zero values are restored and the program returns to BASIC for updating, then back into the loop to get five more tracks.

## The Error Routine

If an error occurs while reading from the disk, the ERROR routine increments an error counter, then fills with

### Listing 1 (Continued)

```

560 PRINT : INPUT " REBUILD ANOTHER DISK? ",A$  

570 IF A$="Y" THEN 270  

580 END  

590 PRINT : PRINT  

600 PRINT " **** TAPE READ ERROR ****"  

610 PRINT : INPUT " WANT TO TRY AGAIN? ",A$: IF A$="Y"  

620 END

```

### Listing 2

```

1 ORG $800  

2 OBJ $6000  

3 *  

4 *****  

5 *  

6 * DISK TO TAPE *  

7 * BACKUP *  

8 *  

9 * BY *  

10 * R.C.M. *  

11 * 7/13/81 *  

12 *  

13 *****  

14 *  

15 IOBADD EQU $00  

16 DRIVE EQU $02  

17 TRACK EQU $03  

18 SECTOR EQU $04  

19 COMAND EQU $05  

20 ERR1 EQU $06  

21 COUNT EQU $07  

22 READCH EQU $08  

23 BUFL0 EQU $09  

24 BUFHI EQU $0A  

25 CH EQU $24  

26 A1L EQU $3C  

27 A1H EQU $3D  

28 A2L EQU $3E  

29 A2H EQU $3F  

30 RWTS EQU $3D9  

31 FNDIOB EQU $3E3  

32 TEMP EQU $900  

33 SAVE EQU $FF4A  

34 RESTORE EQU $FF3F  

35 WRITE EQU $FECD  

36 READ EQU $FEFD  

37 PRBLNK EQU $F948  

38 PRBYTE EQU $FDDA  

39 CROUT EQU $FD8E  

40 *  

0800: 08 08 41 DA TOTAPE.  

0802: 21 08 42 DA FRMTAPE.  

0804: B5 08 43 DA SECLEN  

0806: 74 08 44 DA SECNUM  

45 *  

0808: 20 4A FF 46 TOTAPE JSR SAVE.  

080E: 20 D7 08 47 JSR SAV1.  

080E: 20 4B 08 48 JSR SETUP.  

0811: A9 01 49 LDA #$01 * SET READ COMMAND.  

0813: 85 05 50 STA COMAND.  

0815: 20 7A 08 51 JSR GETRAX.  

0818: 20 A9 08 52 JSR SETTAP.  

081B: 20 CD FE 53 JSR WRITE.  

081E: 4C E2 08 54 JMP REST1.  

55 *  

0821: 20 4A FF 56 FRMTAPE JSR SAVE.  

0824: 20 D7 08 57 JSR SAV1.  

0827: 20 4B 08 58 JSR SETUP.  

082A: A9 02 59 LDA #$02 * SET WRITE MODE  

082C: 85 05 60 STA COMAND.  

082E: 20 A9 08 61 JSR SETTAP.  

0831: A5 24 62 LDA CH.  

0833: 85 08 63 STA READCH.  

0835: 20 FD FE 64 JSR READ.  

0838: A5 24 65 LDA CH.  

083A: C5 08 66 CMP READCH.  

083C: F0 07 67 BEQ OK.  

083E: A9 80 68 LDA #$80  

0840: 85 06 69 STA ERR1.  

0842: 4C E2 08 70 JMP REST1.  

0845: 20 7A 08 71 OK JSR GETRAX.  

0848: 4C E2 08 72 RTS JMP REST1.  

73 *  

084B: 20 E3 03 74 SETUP JSR FNDIOB * GET IOB ADDRESS

```

**Listing 2 (Continued)**

```

084E: 84 00 75    STY IOBADD * AND SAVE AT IOBADD
0850: 85 01 76    STA IOBADD+1
0852: A9 05 77    LDA #$05 * SET TRACK COUNT TO 5
0854: 85 07 78    STA COUNT.
0856: A9 10 79    LDA #$10 * SET BUFFER TO $1000
0858: 85 0A 80    STA BUFHI.
085A: A5 02 81    LDA DRIVE * GET DRIVE *
085C: A0 02 82    LDY #$02
085E: 91 00 83    STA (IOBADD),Y
0860: A9 00 84    LDA #$00
0862: 85 04 85    STA SECTOR * SET SECTOR 0
0864: 85 06 86    STA ERR1 * ZERO ERR BYTE
0866: 85 09 87    STA BUFLO.
0868: C8 88
0869: 91 00 89    INY
086B: A0 08 90    STA (IOBADD),Y * SET VOLUME TO 0
086D: 91 00 91    LDY #$08
086F: 60          STA (IOBADD),Y * SET LOW BUFFER ADDRESS
0870: 92          RTS1
0871: 93          RTS
0870: E6 0A 94    LOOP1  INC BUFHI * NEXT MEMORY PAGE
0872: A5 04 95    LDA SECTOR * NEXT SECTOR
0874: C9 0F 96    SECNUM CMP #$0F
0876: F0 24 97    BEQ NXTRAK * DONE WITH THIS TRACK
0878: E6 04 98    INC SECTOR * TO NEXT SECTOR
087A: A5 03 99    GETRAX LDA TRACK.
087C: A0 04 100   LDY #$04 * SET TRACK TO READ
087E: 91 00 101   STA (IOBADD),Y
0880: C8 102
0881: A5 04 103   INY
0883: 91 00 104   LDA SECTOR * SECTOR TO READ
0885: A5 05 105   STA (IOBADD),Y
0887: A0 0C 106   LDA COMMAND * READ OR WRITE
0889: 91 00 107   LDY #$0C
088B: A5 04 108   STA (IOBADD),Y
088D: A0 09 109   LDA BUFHI * SET MEMORY PAGE
088F: 91 00 110   LDY #$09
0891: 20 E3 03 111  STA (IOBADD),Y
0894: 20 D9 03 112  JSR FNIDIOB * ADDRESS OF IOB
0897: B0 21 113    JSR RWTS * READ T/S
0899: 4C 70 08 114  BCS ERROR * IF CARRY SET THEN ERROR
0899: 115          JMP LOOP1 * GET NEXT SECTOR
089C: C6 07 116    NXTRAK DEC COUNT * 5 TRACKS PER LOAD
089E: F0 CF 117    BEQ RTS1 * IF DONE
08A0: E6 03 118    INC TRACK.
08A2: A9 00 119    LDA #$00 * RESET TO SECTOR ZERO
08A4: 85 04 120    STA SECTOR.
08A6: 4C 7A 08 121  JMP GETRAX.
08A7: 122          *
08A9: A9 00 123    SETTAP LDA #$00 * SET BOUNDARY FOR TAPE MOVE
08AB: 85 3C 124    STA A1L.
08AD: A9 FF 125    LDA #$FF
08AF: 85 3E 126    STA A2L.
08B1: A9 10 127    LDA #$10
08B3: 85 3D 128    STA A1H.
08B5: A9 5F 129    SECLEN LDA #$5F
08B7: 85 3F 130    STA A2H.
08B9: 60          131    RTS
08B9: 132          *
08BA: E6 06 133    ERROR INC ERR1 * INCREMENT COUNTER
08BC: A9 00 134    LDA #$00 * FILL SECTOR WITH ZEROS
08BE: A8 135
08BF: 91 09 136    ERLOOP TAY
08C1: C8 137    STA (BUFLO),Y
08C2: D0 FB 138    INY
08C4: A5 03 139    BNE ERLOOP.
08C6: 20 DA FD 140  LDA TRACK * PRINT BAD TRACK & SECTOR
08C8: 20 48 F9 141  JSR PRBYTE.
08CC: A5 04 142    LDA SECTOR.
08CE: 20 DA FD 143  JSR PRBLNK.
08D1: 20 8E FD 144  JSR CROUT.
08D4: 4C 70 08 145  JMP LOOP1.
08D7: 146          *
08D9: A2 10 147    SAV1 LDX #$10
08D9: B5 00 148    SAVLOP LDA $00,X
08DE: 9D 00 09 149  STA TEMP,X
08DE: E8 150
08DF: D0 F8 151    INX
08E1: 60          152    BNE SAVLOP.
08E1: 153          *
08E2: A2 10 154    REST1 LDX #$10
08E4: BD 00 09 155  RESTLOP LDA TEMP,X
08E7: 95 00 156    STA $00,X
08E9: E8 157
08EA: D0 F8 158    INX
08EC: 20 3F FF 159  BNE RESTLOP.
08EF: 60          160    JSR RESTORE.
08EF: 160          RTS * RETURN TO CALLER

```

zeros that page in the buffer that didn't receive any data. Finally it prints the faulty track and sector location to the screen and returns to read the next sector.

**The BASIC Program**

A routine which checks out the system to see which DOS is in effect is at the beginning of the BASIC program. If it is 3.2, values are POKE'd into two locations of the assembly routine. These routines define the read buffer boundaries and the number of sectors per track to read. If the RWTS pointers on page three are missing, an error message is encountered and the program tells you to reboot the disk before running the program again.

The BASIC portion of this program is straightforward with one exception. Line 70 contains the illegal command LOMEM:. Before entering any part of the BASIC program, first type NEW to kill any existing program. As the first line of BASIC, type "70 LIST 24576". Next type CALL - 151 to get to the monitor. When in the monitor, type CA CB and RETURN to find the pointers for the start of the program (low byte first). On a 48K machine this will be \$95FB.

Print \$95FBL to get a list of the tokenized program. About four numbers from the start, you should find a \$74 character. Change this to \$11 and then re-enter BASIC with a control C. Now LIST the program and you should see "70 LOMEM:24576". Now type in the rest of the BASIC program and save it to disk.

**Save the Machine Code**

After assembling the machine code, save it on disk with the command "BSAVE TAPBAK.OBJ,A\$800,L\$F0". This routine will be loaded from line 90 of the integer routine when it is first run.

**Caution**

If you are using the DOS 3.3 and have 3.2 disks that have been modified with one of the universal boot routines, you may experience difficulty in using this backup routine. There are just too many sectors in the modified DOS that cannot be read by the 3.2 RWTS routine. My suggestion is to first MUFFIN all the programs onto a 3.3 disk and then make the backup for that disk. They can later be DEMUFFINED to another universal 3.2 disk if desired.

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# AIM User Function Dispatcher

by Joel Swank

**Overcome the AIM's limitation of three user-definable keys with "Function Dispatcher." Up to 85 different commands may be defined. Four samples are provided.**

## Function Dispatcher

requires:

AIM 65

The AIM 65 monitor reserves three keys for user-written commands. Pressing one of these keys causes a jump to a vector in RAM page one. You can then put a jump to your routine in this vector. It is convenient to be able to execute a program with a single key-stroke. But the programs available for the AIM far outnumber the available keys. And most of the AIM disk systems use one or two of these keys. In addition, relatively inexpensive 16K and 32K RAM boards are now available that allow plenty of space to keep many frequently used utilities resident in memory. Some RAM boards even have the ability to write-protect sections of memory, making them perfect for containing user extensions of the AIM monitor. The AIM needs a way to execute many more than three user commands; User Function Dispatcher fills this need.

The dispatcher expands one of the AIM user function keys to allow execution of nearly as many routines as there are characters on the AIM keyboard. The limit is actually 85 because the command table is limited to 255 bytes. Listing 1 includes the dispatcher and four sample commands executed through the F3 key. The command names may be multiple characters, but only the first character is entered to execute the command. For example, to execute the clear command you press the F3 key and the 'C' key; the dispatcher then

echoes 'CLEAR'. This feature not only gives visual confirmation that you are executing the proper command, but also makes the commands easier to remember.

You may add your own routines to the dispatcher by adding entries to the command table. Each entry in the table is composed of three or more bytes. The first byte is the character that must be entered to execute the command. The rest of the command name follows. The last character of the name must have the high bit of the byte set to one. The name may be as long as you like, but the entire table is limited to 255 bytes. Following this is the two-byte address of the start of the routine in normal low-byte, high-byte order. The table must end with a \$00 byte. The routine should end with a jump to the monitor at address \$E1A1.

The four commands included are VIEW, CLEAR, ECHO and TEST. VIEW displays a section of memory in hex and ASCII. It requests that the starting and ending addresses of the memory be displayed with the standard 'FROM =' and 'TO =' prompts. It then uses the 'OUT =' prompt to allow you to direct the display to any system device. If the output device is tape, VIEW sends a double CR and a control-Z to end the display and closes the file. This allows the output to be read back by either the AIM editor or BASIC. VIEW calls AIM subroutine RCHEK at the end of each line to allow you to stop or cancel the display.

CLEAR, a routine to clear the AIM editor buffer, allows you to delete all text in the editor buffer without reinitializing the editor.

ECHO is a routine that executes from the AIM DILINK vector. ECHO sends a copy of AIM keyboard/display I/O to the TTY port. This allows you

to work from the AIM keyboard/display but get a copy of everything on your TTY or CRT. The ECHO command is used to toggle this feature on and off. ECHO responds with the standard 'ON' and 'OFF' messages. You may use ECHO even if you do not have a CRT or TTY to slow the display by setting the terminal speed to a low baud rate. Page 9-32 of the *AIM Users Guide* explains how to set the terminal speed. ECHO has no effect when in TTY mode. Because of the way ECHO is implemented, it will not execute from ROM or write-protected RAM.

TEST is a dummy command to allow easy testing of new routines. The address in the table for TEST is the monitor return, \$E1A1. To use TEST, replace this address with the address of the routine to be tested. Below is a sample run of the four commands.

### Sample Run

```
<†>VIEW FROM=E000 TO=E022 OUT=
E000 46524F4D FROM
E004 BD544FB0 TO
E008 202A2A2A ***
E00C 2A205053 * PS
E010 20414120 AA
E014 58582059 XX Y
E018 592053D3 Y S
E01C 4D4F5245 MORE
E020 BF4F4EA0 ON
<†>CLEAR
<†>TEST
<†>ECHO ON
<†>ECHO OFF
<
```

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**Listing 1**

```

;*
;* AIM-65 USER FUNCTION DISPATCHER
;*
;EXPANDS THE F3 KEY TO DISPATCH UP TO 85 USER COMMANDS
;
;ZERO PAGE
;
CMDSAV EPZ $25      ;COMMAND SAVE AREA
STRL EPZ $26        ;START OF LINE
STRI EPZ $27        ;TOP OF TEXT
BOTIN EPZ $E1        ;BOTTOM OF TEXT
TEXT EPZ $E3        ;START OF TEXT BUFFER
;
;AIM SUBROUTINES
;
FROM EQU $E7A3      ;INPUT FROM ADDRESS
TO EQU $E7A7        ;INPUT TO ADDRESS
RCHEK EQU $E907      ;CHECK FOR INTERRUPT
CRIF EQU $E9F0      ;SEND CR & LF
NUMA EQU $EA46      ;SEND ACCUM IN HEX
OUTALL EQU $E9BC    ;SEND ACCUM TO AOD
WHERO EQU $E871    ;OPEN OUTPUT DEVICE
DUL2 EQU $E511      ;CLOSE TAPE FILE
READ EQU $E93C      ;INPUT FROM KBD WITHOUT ECHO
CKEROO EQU $E394    ;DISPLAY 'ERROR'
COMIN EQU $E1A1      ;RETURN TO AIM
OUTPUT EQU $E97A    ;DISPLAY CHAR IN ACCUM
BRK3 EQU $E6F1      ;DISPLAY 'OFF'
BRK4 EQU $E6FA      ;DISPLAY 'ON'
DILINK EQU $A406    ;DISPLAY VECTOR
OUTTY EQU $EEA8      ;OUTPUT TO TTY
;
;AIM RAM
;
CURAD EQU $A41C    ;SUBSTITUTE BLANK
OUTFLG EQU $A413    ;PRINT IT
;
;EQUATES
;
CTLZ EPZ $1A        ;NOW IN ASCII
;
ORG $112          ;GET A CHARACTER
;
0112 4C 00 OE      ;SKIP NON ASCII
0115 :             ;AND CONTROL CHARACTERS
0E00 ORG $E00        ;SUBSTITUTE BLANK
0E00 ;             ;PRINT IT
0E00 20 3C E9 UFD  ;INIT USER F3 VECTOR
0E00 20 3C E9 UFD  ;GET COMMAND CHARACTER
0E03 A2 00 LDX #$00  ;CLEAR INDEX
0E05 85 25 STA CMDSAV ;SAVE COMMAND
0E07 BD 42 OF NXTENT LDA CMDTBL,X ;COMMAND FROM TABLE
0E0A FO 30 BEQ NOFOUN ;QUIT ON NULL
0E0C 29 7F AND #$7F ;CLEAR HIGH BIT
0E0E C5 25 CMP CMDSAV ;MATCH?
0E10 FO 0D BEQ EXECMD ;YES, GO DISPATCH
0E12 ;             ;NOPE
0E12 ;             ;PRINT LAST LINE
0E12 ;             ;NEXT COMMAND
0E12 ;             ;PRINT IT
0E12 BD 42 OF SKLUP LDA CMDTBL,X ;GET A CHARACTER
0E15 30 03 BMI SKIPAD ;QUIT IF HIGH BIT IS 1
0E17 E8 INX          ;NEXT CHARACTER
0E18 DO F8 BNE SKLUP ;SKIP ADDRESS
0E1A E8 INX          ;NEXT CHARACTER
0E1B E8 INX          ;NEXT CHARACTER
0E1D DO E8 BNE NXTENT ;NEXT CHARACTER
0E1F ;             ;NOPE
0E1F BD 42 OF EXECMD LDA CMDTBL,X ;GET A COMMAND CHARACTER
0E22 48 PHA          ;NEXT CHARACTER
0E23 20 7A E9 JSR OUTPUT ;ECHO CHARACTER
0E26 68 PLA          ;NEXT CHARACTER
0E27 30 03 BMI GETADD ;QUIT IF HIGH BIT ON
0E29 E8 INX          ;NEXT CHARACTER
0E2A DO F3 BNE EXECMD ;NEXT CHARACTER
0E2C E8 GETADD INX ;MOVE ADDRESS OF ROUTINE
0E2D BD 42 OF LDA CMDTBL,X ;TO CURAD
0E30 8D 1C A4, STA CURAD+1 ;MOVE ADDRESS OF ROUTINE
0E33 BD 43 OF LDA CMDTBL+1,X ;TO CURAD
0E36 8D 1D A4 STA CURAD+1 ;MOVE ADDRESS OF ROUTINE
0E39 6C 1C A4 JMP (CURAD) ;JUMP TO IT
0E3C ;             ;UNKNOWN COMMANDS
0E3C ;             ;CLEAR—
0E3C 20 94 E3 JSR CKEROO ;DISPLAY 'ERROR'
0E3F 4C A1 E1 JMP COMIN ;RETURN TO AIM
0E42 ;             ;CLEAR THE EDIT BUFFER
0E42 ;             ;CALLING FORMAT:
0E42 ;             ;VIEW—

```

**Listing 1 (Continued)**

```

0E42 ;             ;SEND A SPACE
0E42 ;             ;GET FROM ADDRESS
0E42 ;             ;SAVE ADDRESS
0E42 ;             ;PRINT ADDRESS
0E42 20 E7 0E VIEW JSR BLANK ;SEND A SPACE
0E45 20 A3 E7 JSR FROM ;GET FROM ADDRESS
0E48 B0 F8 BCS VIEW ;PRINT ADDRESS
0E4A AD 1C A4 LDA CURAD ;SAVE ADDRESS
0E4D 85 26 STA STRL ;PRINT ADDRESS
0E4F AD 1D A4 LDA CURAD+1 ;PRINT ADDRESS
0E52 85 27 STA STRI ;PRINT ADDRESS
0E54 20 A7 E7 VTL JSR TO ;GET END ADDRESS
0E57 B0 FB BCS VTL ;PRINT ADDRESS
0E59 20 71 E8 JSR WHERBO ;GET OUTPUT DEVICE
0E5C 4C 65 0E JMP FIRST ;CHECK FOR INTERRUPT
0E5F 20 07 E9 MORE JSR RCHEK ;NEW LINE
0E62 20 FO E9 JSR CRIF ;PRINT ADDRESS
0E65 A5 27 FIRST LDA STRI ;PRINT ADDRESS
0E67 20 46 EA JSR NUMA ;PRINT ADDRESS
0E6A A5 26 LDA STRL ;PRINT ADDRESS
0E6C 20 46 EA JSR NUMA ;PRINT ADDRESS
0E6F 20 E4 0E JSR BLANK2 ;PRINT BLANKS
0E72 A0 00 LDY #$00 ;PRINT BLANKS
0E74 B1 26 BYLUP LDA (STRL),Y ;GET A CHARACTER
0E76 20 46 EA JSR NUMA ;PRINT IT IN HEX
0E79 C8 INY ;PRINT IT IN HEX
0E7A C0 04 CPY #$04 ;IN GROUPS OF 4
0E7C D0 F6 BNE BYLUP ;PRINT IT IN HEX
0E7E 20 E4 0E JSR BLANK2 ;PRINT BLANKS
0E81 A0 00 LDY #$00 ;PRINT BLANKS
0E83 B1 26 ASLUP LDA (STRL),Y ;GET A CHARACTER
0E85 30 04 BMI PBL ;SKIP NON ASCII
0E87 C9 20 CMP #$20 ;AND CONTROL CHARACTERS
0E89 B0 02 BCS PTO ;SUBSTITUTE BLANK
0E8B A9 20 PBL LDA ' ' ;PRINT IT
0E8D 20 BC E9 PTO JSR OUTALL ;PRINT IT
0E90 C8 INY ;PRINT IT IN HEX
0E91 C0 04 CPY #$04 ;IN GROUPS OF 4
0E93 D0 EE BNE ASLUP ;PRINT IT IN HEX
0E95 18 CLC ;PRINT IT IN HEX
0E96 A5 26 LDA STRL ;PRINT ADDRESS
0E98 69 04 ADC #$04 ;ADD 4 TO POINTER
0E9A 85 26 STA STRL ;PRINT ADDRESS
0E9C 90 02 BCC PCY ;PRINT ADDRESS
0E9E E6 27 INC STRI ;PRINT ADDRESS
0EA0 A5 27 PCY LDA STRI ;CHECK FOR END
0EA2 CD 1D A4 CMP CURAD+1 ;GET HIGH BYTE OF POINTER
0EA5 90 B8 BCC MORE ;QUIT IF GREATER
0EA7 D0 09 BNE DFIN ;EQUAL, CHECK LOW
0EA9 A5 26 LDA STRL ;PRINT ADDRESS
0EAB CD 1C A4 CMP CURAD ;CONTINUE IF LESS THAN OR =
0EAE FO AF BBE MORE ;PRINT IT
0EBO 90 AD BCC MORE ;PRINT IT
0EBC 4C A1 E1 JMP COMIN ;PRINT IT
0E2 AD 13 A4 DFIN LDA OUTFLG ;USER OUTPUT?
0E85 C9 50 PRCHEK CMP 'P' ;PRINTER?
0E87 D0 06 BNE TAPCK ;NOPE
0E89 20 FO E9 JSR CRLF ;PRINT LAST LINE
0EBC 4C A1 E1 JMP COMIN ;PRINT IT
0E8F ;             ;TAPE?
0E8F C9 54 TAPCK CMP 'T' ;NOPE
0E81 D0 09 BNE UCHK ;SEND EOF CHARS
0E83 20 D6 0E JSR ENDUO ;YES, CLOSE IT
0E86 20 11 E5 JSR DU12 ;RETURN TO AIM
0E89 4C A1 E1 JMP COMIN ;PRINT IT
0E8C ;             ;USER?
0E8C C9 55 UCHK CMP 'U' ;NO
0E8E D0 03 BNE OUT ;SEND EOF CHARS
0E8D 20 D6 0E JSR ENDUO ;YES, SEND EOF CHARS
0E83 4C A1 E1 OUT JMP COMIN ;RETURN TO AIM
0E86 ;             ;END LINE
0E86 20 FO E9 ENDUO JSR CRLF ;SEND A CONTROL 'Z'
0E89 A9 1A LDA #CTLZ ;AND A COUPLE OF CR'S
0E8B 20 BC E9 JSR OUTALL ;MOVE ADDRESS OF ROUTINE
0E8E 20 FO E9 JSR CRLF ;MOVE ADDRESS OF ROUTINE
0E81 4C FO E9 JMP CRLF ;MOVE ADDRESS OF ROUTINE
0E84 ;             ;MOVE ADDRESS OF ROUTINE
0E84 20 E7 0E BLANK2 JSR BLANK ;MOVE ADDRESS OF ROUTINE
0E87 A9 20 BLANK LDA #$20 ;MOVE ADDRESS OF ROUTINE
0E89 4C BC E9 JMP OUTALL ;MOVE ADDRESS OF ROUTINE
0E8C ;             ;CLEAR—
0E8C ;             ;CLEAR THE EDIT BUFFER
0E8C ;             ;CALLING FORMAT:

```

**Listing 1 (Continued)**

```
OEBC      ; <^>CLEAR
OEBC      ;
OEBC A5 E3  CLEAR  LDA TEXT      ;COPY BUFFER START ADD
OEBC 85 E1  STA BOTLN    ;TO TEXT END ADD
OEOF A5 E4  LDA TEXT+1
OEOF 85 E2  STA BOTLN+1
OEOF A9 00  LDA #$00      ;FLAG END OF TEXT
OEOF AB    TAY
OEOF 91 E3  STA (TEXT),Y
OEOF 94 C1 E1  JMP COMIN    ;RETURN TO AIM
OEOF      ;
OEOF      ;*
OEOF      ;* ECHO TO TTY ROUTINE
OEOF      ;*
OEOF      ;
OEOF      ;CALLING FORMAT--
OEOF      ;
OEOF      ; <^>ECHO ON
OEOF      ; <^>ECHO OFF
OEOF      ;
OEOF 48    ECHO  PHA
OEFD 29 7F  AND #$7F      ;CLEAR 4HIGH BIT
OEOF C9 0D  CMP #$0D      ;CR?
OFO1 D0 0A  BNE NOLF    ;NO, SKIP IT
OFO3 20 A8 EE JSR OUTTYY  ;YES, SEND IT
OFO6 A9 0A  LDA #$0A      ;SEND LF
OFO8 20 AB EE JSR OUTTYY
OFOB 68    PLA
OFOC 60    RTS
OFOF 68    NOLF  PLA
OFOE 4C A8 EE JMP OUTTYY  ;DISPLAY CHAR
OF11      ;
OF11      ;ROUTINE TO TOGGLE ECHO ON AND OFF
OF11      ;
OF11 20 E7 0E TOGG  JSR BLANK  ;SEND A SPACE
OF14 AD 07 A4  LDA DILINK+1  ;SAVE CURRENT CONTENTS
                    IF DILINK
OF17 48    PHA
OF18 AD 06 A4  LDA DILINK
OF1B 48    PHA
OF1C AD 40 0F  LDA SAVE     ;MOVE CONTENTS OF
                    SAVE AREA
OF1F 8D 06 A4  STA DILINK
OF22 AD 41 0F  LDA SAVE+1
OF25 8D 07 A4  STA DILINK+1
OF28 68    PLA
OF29 8D 40 0F  STA SAVE     ;TO DILINK
OF2C 68    PIA
OF2D 8D 41 0F  STA SAVE+1
OF30 C9 0E  CMP /$00
OF32 D0 06  BNE ON
OF34 20 F1 E6  JSR BRK3
OF37 4C A1 E1  JMP COMIN
OF3A 20 FA E6  ON   JSR BRK4
OF3D 4C A1 E1  JMP COMIN
OF40      ;
OF40 FC 0E  SAVE  ADR ECHO  ;MAKES ECHO NON-RROMMABLE
OF42      ;*
OF42      ;* COMMAND TABLE
OF42      ;*
OF42 56 49 45 CMDTBL  ASC 'VIE'  ;VIEW
OF45 D7    BYT $D7      ;'W' OR $80
OF46 42 0E  ADR VIEW
OF48 43 4C 45 ASC 'CLEA'  ;CLEAR
OF4B 41    BYT $D2      ;'R' OR $80
OF4D EC 0E  ADR CLEAR
OF4F 45 43 48 ASC 'BOH'   ;ECHO
OF52 CF    BYT $C9      ;'O' OR $80
OF53 11 0F  ADR TOGG
OF55 54 45 53 ASC 'TES'   ;TEST
OF58 D4    BYT $D4      ;'T' OR $80
OF59 A1 E1  ADR COMIN
OF5B      ;
OF5B      ;ADD MORE COMMANDS HERE
OF5B      ;
OF5B 00    BYT $00      ;MUST END WITH ZERO
OF5C      ;
OF5C      END
```

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# Additional Output Ports for KIM

by S. Henning

## This hardware modification allows your KIM to support seven additional output ports.

Ralph Tenny described, in the May 1980 issue of MICRO, a technique to increase the number of usable I/O ports on the KIM-1 without adding additional hardware. The KIM-1 features 15 user accessible I/O lines. It has an additional 15 lines which are dedicated to the built-in keyboard and LED display. Tenny described how to use them as additional *input* lines.

My requirement was different. I needed additional *output* lines. I used seven lines to attach an ASCII keyboard — three more for Lew Edwards' Ziptape, plus a memory management unit.

So, when I wanted to add an output printer, I needed an additional seven output lines. Rather than adding an additional 6530 or 6522, I decided to use the approach described by Ralph Tenny.

Inspection of figure 3.5 in the KIM-1 user manual indicated a problem. The important parts are reproduced in figure 1. Port A of the 6530 nicely provides the required seven lines; they are even accessible at the application connector. However, they are already loaded with one standard TTL load, so even adding a 74LSxx circuit would exceed the maximum permissible load.

This is the solution: U17 and U26 in figure 1 go only to resistors R26 through

### Listing 1

A9 3F	LDAIM	3F
8D 43 17	STA	PBDD
A9 15	LDAIM	15
8D 42 17	STA	SBD
A9 7F	LDAIM	7F
8D 41 17	STA	PADD
AD xx xx	LDA	xx
8D 40 17	STA	SAD
A9 00	LDAIM	00
8D 41 17	STA	PADD
60	RTS	port A to input

R32, which are 82 Ohm each. An additional 74LSxx load can be added to the output of U17 and U26 without overloading the circuit. Figure 2 shows the location of these resistors on the KIM-1. They are readily accessible, and soldering seven wires to them is done easily.

These are the required connections:

### Port Connection to

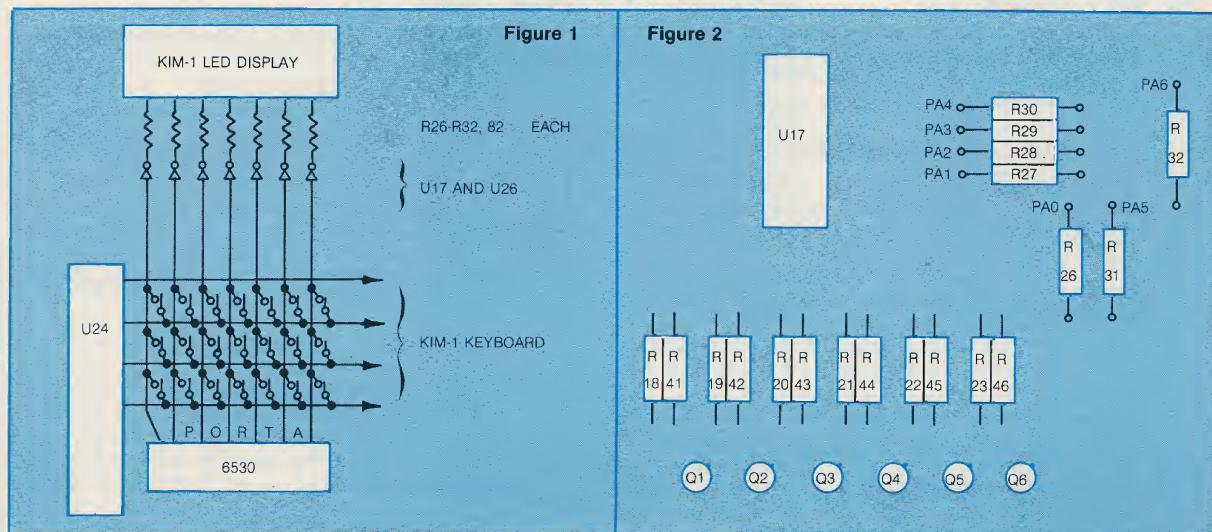
PA0	R26, top side
PA1	R27, left side
PA2	R28, left side
PA3	R29, left side
PA4	R30, left side
PA5	R31, top side
PA6	R32, top side

The subroutine in listing 1 outputs one byte to the new port.

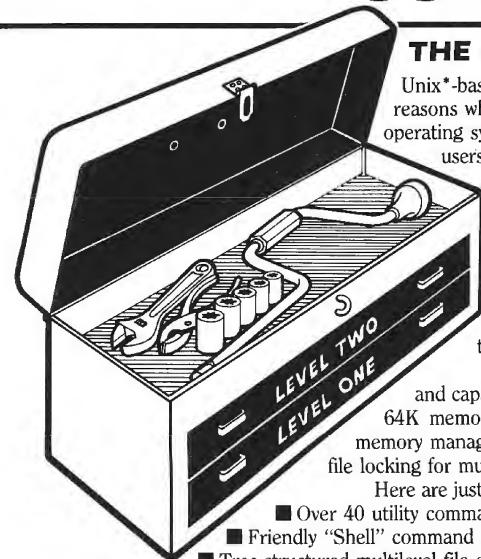
Because of U17 and U26, the output byte will be inverted. Re-inverting it by hardware or by software is up to the user.

The author may be contacted at Howard Johnson's Motor Lodge, 290 Tarrytown Road, Elmsford, NY 10523.

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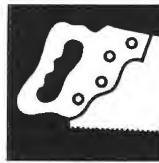
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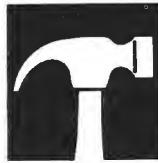
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# Add a VIA and Speech Synthesizer to the Color Computer

by William C. Clements, Jr.

**Add two user-accessible, 8-bit bidirectional I/O ports to your color computer and interface an inexpensive speech synthesizer.**

**Requires:**

TRS-80 Color Computer

The Radio Shack Color Computer is quite a machine for the money, as recent reviews in several magazines have indicated. Moreover, it's an easy and inexpensive way to become acquainted with the MC6809 microprocessor.

Since the Color Computer is still relatively new, the Color devotee must devise many of his own modifications and software. More often than not, he is left to gaze longingly at dozens of articles in the "just what I need except it's for another computer" category.

I began microcomputing on a well-expanded KIM system, and have several KIM-driven peripherals that would work well with the Color Computer. I had also become used to KIM's parallel ports with individually programmable I/O lines and the hardware timer. The Color Computer does have a serial port and joystick A/D converters, but some tasks are easier done with TTL-compatible bidirectional I/O ports.

Fortunately, the cartridge connector provides access to data and address busses and all important control signals, as well as to a few handy features like decoded address selects. It's easy to expand the machine with the same hardware you would add to the busses of a member of the AIM/SYM/KIM (ASK) computer family. In fact, you could adapt many published applications for the single-board 6502 machines to the Color Computer if there were 6522- or 6530-style I/O lines and timers. You would need to convert their 6502 driver software into either Color BASIC or 6809 machine

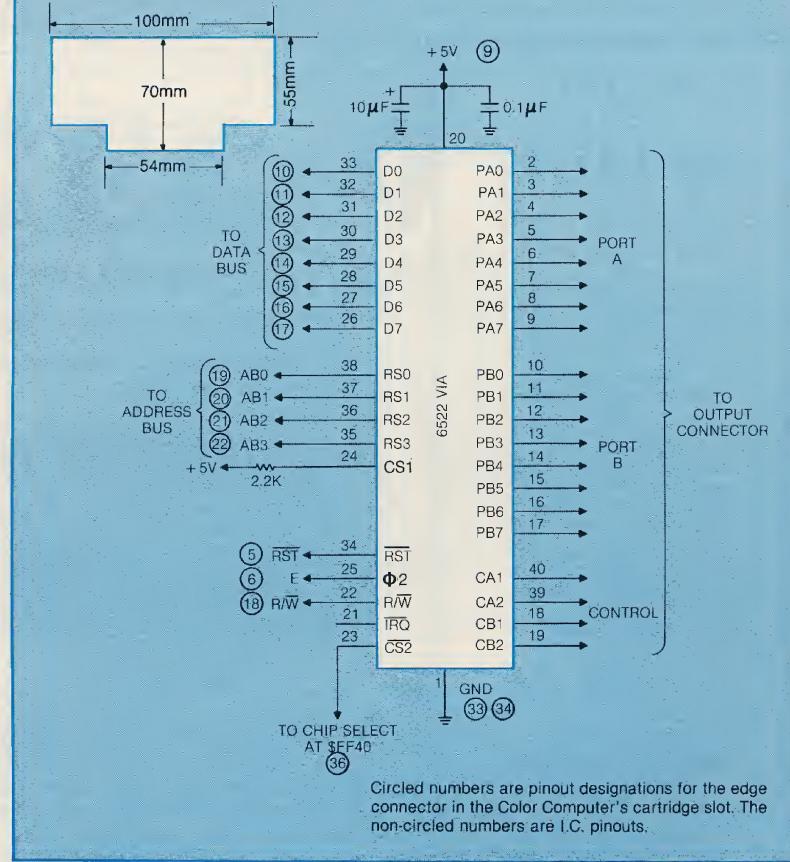
code. Then devices such as parallel-data printers, the MTU music synthesis D/A unit, the Optimal Technology Co. EPROM programmer, and the Sweet-Talker speech synthesizer sold by Micromint, Inc., could be used with the Color Computer.

(VIA) to the Color Computer through its cartridge connector. BASIC driver routines and interface connections for the Sweet-Talker illustrate a simple application for the new I/O ports.

## The VIA Interface Board

The VIA is well known to ASK computer users, thanks to Dr. DeJong's

Figure 1: Circuit Diagram and Dimensions for the VIA Board



MICRO articles<sup>1, 2</sup> and his excellent book<sup>3</sup>, and by its use in the SYM and AIM machines. Adding the VIA to the Color Computer provides two 8-bit parallel I/O ports with individually programmable bits, two interval timers with several different modes of use, and parallel-serial data interconversion (if you need more capability than the Color Computer's serial port can provide). These items, plus the serial output, the cassette interface, and the two joystick A/D channels already on the machine, give you quite a versatile system.

Figure 1 is a simple schematic diagram of the 6522 board. You will have to provide edge fingers to plug into the female edge-connector in the cartridge compartment. I took a piece of un-etched double-sided circuit board stock, cut it to the approximate dimensions of the printed circuit board inside the Tandy cartridges (again see figure 1), and laid down 40 strips of 1.5 mm wide tape, 20 per side with 0.1 inch spacing, on the edge. A couple of wider strips at the board sides were put down to make +5V and ground busses. I made my own resist tape by slitting a piece of Scotch Filament tape with a

#### Listing 1

```

1 DATA57,9,31,62
2 DATA9,18,31,62
3 DATA41,52,53,43,62
4 DATA25,51,24,49,43,62
5 DATA25,51,12,37,27,54,42,58,62
6 DATA31,37,44,25,39,20,62
8 A=65344
10 DIMZ(100)
20 POKEA+3,255:POKEA+2,6
30 P=63:GOSUB1000
40 FORN=1TO35:READZ(N):NEXTN
50 N=N-1
60 FORI=1TON:P=Z(I):GOSUB1000
70 NEXTI:STOP
1000 POKEA,0:POKEA+1,P:POKEA,2
1010 IF (PEEK(A) AND 1) THEN RETURN ELSE 1010

```

#### Listing 2

```

1 'VIA AT $FF40
5 A=65344:N=0
10 DIMZ(100)
15 'PORT A = OUTPUTS: PB0 = INPUT, PB1,PB2 = OUTPUTS
20 POKEA+3,255:POKEA+2,6
25 'SEND STOP-PHONEME & SILENCE SYNTHESIZER
30 P=63:GOSUB1000
33 'INPUT PHONEME CODES
36 'WHEN READY TO HEAR THEM, INPUT ANY NEGATIVE NO.
40 N=N+1:INPUTZ(N):IFZ(N)=0 THEN 40
50 N=N-1
55 'SEND PHONEME CODES OUT TO SYNTHESIZER
60 FORI=1TON:P=Z(I):GOSUB1000
70 NEXTI:N=0:GOTO30
999 'TAKE ENABLE AND STB LOW
1000 POKEA,0
1005 'PLACE PHONEME CODE ONTO PORT A
1010 POKEA+1,P
1015 'TAKE STB HIGH AGAIN
1020 POKEA,2
1025 'RETURN WHEN A/R GOES HIGH
1030 IF (PEEK(A) AND 1) THEN RETURN ELSE 1030

```

razor blade. This tape is cheaper than commercial resist, sticks very tightly to copper, and is impervious to ferric chloride etchant.

After etching, I drilled the holes to accommodate a low-profile 6522 socket. Then the socket was epoxied in place and the circuit was wired point-to-point with wire-wrap wire and a fine soldering pencil. Unfortunately, there is not enough vertical clearance inside the cartridge slot of the computer to use wire-wrap construction.

On my unit, the port lines, control lines, and the +5V, +12V, and ground lines were all brought out to a right-angle DB-25 connector mounted at the rear center of the circuit board. You may prefer to use a less expensive 24-pin DIP socket or a ribbon cable instead. I didn't plan to use timer-generated interrupts, so I left the IRQ pin unconnected.

Since there was a handy chip-select signal decoded for \$FF40-\$FF5F available on the cartridge connector, I used it to select the VIA. I added just one 6522, so no further decoding was done. This address space will hold two VIAs if you want to add some logic to distinguish between the addresses \$FF40

and \$FF50. In my case, register 0 of the VIA is addressed at \$FF40 with address image at \$FF50, register 1 at \$FF41 with image at \$FF51, and so forth.

For protection and insulation, the circuit board was enclosed in a homemade plastic box about the size of a Tandy cartridge. A slot was cut to allow the contact fingers to protrude through the front of the box. I also cut a hole for the DB-25 output connector in the rear.

#### Now Make It Talk

As a simple and entertaining example of using the 6522 to interface a non-Radio Shack peripheral, let's hook up the Sweet-Talker speech synthesizer recently described in a construction article by Ciarcia<sup>4</sup> and also marketed as an assembled unit by Micromint, Inc. This device, based on the Votrax SC-01 synthesizer chip, is simple to build and use. Speech is generated by cascading phonemes together; there are 64 generated by the SC-01. These phonemes are called out by placing a 6-bit phoneme code onto the Sweet-Talker's data lines (P0-P5) and strobing the synthesizer. Two pitch-control lines, I1 and I2, are available to vary phoneme inflection; their use is optional.

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The data lines (P0-P5) and inflection bits (I1 and I2) together comprise an 8-bit speech-configuration word that is provided in my setup through Port A of the VIA, P0-P5 being driven by PA0-PA5 and I1, I2 by PA6 and PA7. In addition, three control lines must be interfaced. The synthesizer signal A/R requires an input line and is connected to PBO. The STB and enable signals of the Sweet-Talker are driven as outputs from the computer and are connected to PB1 and PB2, respectively. The power requirements are +5 and +12 volts at current levels easily handled by the Color Computer's power supply.

The Sweet-Talker synthesizer must be driven as follows [see reference 1 for detailed explanation and exact definition of the control signals]: initialize the synthesizer by driving STB and enable both low. Place 6-bit phoneme code onto P0-P5 and 2-bit inflection code (if used) on I1 and I2. Latch data into unit by applying rising edge of positive-going pulse to STB. Data must be stable 450 ns prior to rising edge of STB, and STB must have been low at least 100  $\mu$ s before it returns high. About 500 ns after rising edge of STB, A/R goes low, indicating that the synthesizer chip is busy. When A/R is

found again to be high, the chip is ready to accept another phoneme code.

These functions can easily be implemented using a short BASIC or machine-language program. To find out how the synthesizer sounds, attach it to the VIA as indicated above, then enter and run the program in listing 1.

The program in listing 2 lets you experiment with the synthesizer by inputting a series of phoneme codes and then listening to the speech they produce. With the phoneme table in Ciarcia's article and this program, you can generate just about any speech you want. Don't forget to convert the hex codes given in the article into decimal before entering them.

In this article, I have attempted to show how easy it is to connect parallel-mode peripherals to the Color Computer, and to suggest that Color Computer users can now make use of the extensive literature covering 6502-based computer peripherals. If I have lessened even a little the frustration of the Color owner in seeing so many goodies out there for other machines, then I will rate this effort a success.

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W.C. Clements, Jr. is professor of chemical engineering at the University of Alabama. He designed and built several 6502- and 6801-based machines and has developed software for them. Presently, he is designing peripherals and programs for his department's seven color computers. Write to him at the University of Alabama, P.O. Box 2662, University, AL 35486.

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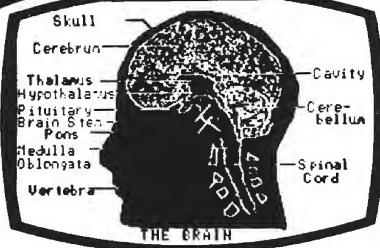
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## The Single Life

By Brad Rinehart

### More About Disk BASIC

Last month we discussed the sequential and snapshot file structures. This month I want to teach you the ins and outs of RANDOM files.

The definition of a random file denotes that it takes the same amount of time to access the last record in the file as it takes to access the first record. To access the last record of a sequential file, all preceding records must first be read.

To date, the most widely used method for determining where a record is located in a random file is to define a fixed record length (in bytes). Then you index the number of bytes times the record number into the file.

HDE disk BASIC defines this record length as 128 bytes, which is the length of one sector. The size of the random file is limited only by the amount of disk space. On an 8" floppy this means about 1975 records.

In HDE Disk BASIC, random files may be either open ended or reserved. If the file is open ended, it may continue to grow until it runs out of disk space. By reserving the file with the RSV command, a unique area of the disk, X number of sectors, may be assigned to the file. I prefer to reserve the file. In figure 1 I illustrate three random files. The first contains ten records, the second eight records, and the third three records.

Let's assume we opened FILE 1, wrote ten records, and then closed it. Next we opened FILE 2, reserved it for eight records, then opened FILE 3 and reserved it for three records. If we try to write record nine to FILE 2 or record four to FILE 3, BASIC will return an error because we tried to write past the end of the reserved area. However, since we did not reserve FILE 1, we could open it and write records 11 and 12 to the file. The shaded area shows where the data would be put. As you can see, we would overwrite information in FILE 2 which could cause some drastic problems. Therefore, reserve the file for the maximum number of records you expect to write.

To review the procedure thus far, we have opened, reserved, and closed files. The instructions for this procedure would look like:

```
10 FILES3
20 OPEN "R", 1, "FILE 1"
30 RSV1, 50
40 CLOSE 1
```

where the FILES command declares that we expect a maximum of three files to be OPEN at one time. This reserves space in memory for three 256-byte file buffers. FILES must be declared *before* any variables are defined.

The OPEN command tells BASIC we wish to access FILE 1. In addition, the "R" denotes that the file is to be opened for RANDOM access. The "1" in the OPEN command tells BASIC we wish to use file buffer 1. HDE BASIC allows up to 32 files to be open *at the same time*. While a file buffer is OPEN, it will access the file named in the OPEN statement. However, if the file is CLOSED, it may be reopened and used to access another named file, as in:

```
50 CLOSE 1
60 OPEN "R", 1, "FILE 2"
```

Since we declared three files, all three may be open at the same time.

The statements:

```
100 OPEN "R", 1, "FILE 1"
110 OPEN "R", 2, "FILE 2"
120 OPEN "R", 3, "FILE 3"
```

will open all three files and allow access to any one or all three of them. Several files may be CLOSED simultaneously by the command CLOSE 1, 2, 3.

I mentioned that random files should be reserved. The reserve or RSV command also provides for initializing an entire file to a pre-defined value. For example the statement:

```
RSV1, 50, CHR$(32)
```

will reserve file number one for fifty records and also write a space, CHR\$(32), in every byte in the file. Any one-byte character may be specified as the fill character.

Figure 1: Random Access Disk Files

FILE 1
1
2
3
4
5
6
7
8
9
10

FILE 2
1
2
3
4
5
6
7
8

FILE 3
1
2
3

After a random file has been opened, the next step is to read and write information from and to it. I stated that HDE BASIC assigns a fixed record length of 128 bytes to each record in the file. This does not mean that every piece of data will use 128 bytes on the disk. A random file record is designed to be fielded, or broken down into one or more smaller fields. A field may consist of as little as one byte, or as many as 128 bytes of information. Fields may overlap, meaning that FIELD A\$ may consist of all or part of FIELD B\$, FIELD C\$, FIELD D\$, etc.

Referring to figure 2, note fields A\$, B\$, and C\$. Field A\$ has a length of 10 bytes, B\$ a length of 20 bytes, and C\$ a length of five bytes. The FIELD command is used to define the particular



will cause record number 5 (128 bytes) of the file to be read into file buffer one.

The statement:

PUT 1, 5

will cause file buffer one (128 bytes) to be written to record number 5 in the file. Unlike sequential files, the random file buffer is not automatically written to the disk when the file is CLOSED. You are responsible for PUTing the record to the file.

HDE has provided two very useful record pointers, LRN and NRN. These two functions first return the Last Record Number and then the Next Record Number of the specified file.

LRN refers to the *highest* record number accessed in the file. For example, if a file has been reserved for 100 records, but only the first 50 have been accessed, the LRN of the file will be 50.

NRN equates to a value that is one higher than the record currently in the file buffer. Consider the previous example. If we access record number 5 via the GET 1, 5 statement, (NRN1) will return a value of six, while (LRN1) will still equal 50.

In the following program, we will OPEN a new file, FIELD it, access some records, and retrieve the values of NRN and LRN.

```
10 FILES 1
20 OPEN "R", 1, "NWFIL"
30 X=(NRN1) : Y=(LRN1)
      REM X=1, Y=0
40 RSV1, 100
50 X=(NRN1) : Y=(LRN1)
      REM X=1, Y=0
60 FIELD 1, 64 AS A$, 64 AS B$
70 GET 1, 25
80 X=(NRN1) : Y=(LRN1)
      REM X=26, Y=25
90 GET 1, 10
100 X=(NRN1) : Y=(LRN1)
      REM X=11, Y=25
110 CLOSE 1
120 OPEN "R", 1, "NWFIL"
130 X=(NRN1) : Y=(LRN1)
      REM X= 1, Y=25
```

Notice that when the file was CLOSED and then reOPENed, LRN was preserved, while NRN was reset to one.

The value of LRN may be reset to zero via the RESTORE# (note the pound sign) command. Referencing the previous program, if we add line 140 to say:

140 RESTORE#1

the value of LRN will equal zero and the value of NRN will equal one.

NRN and LRN may be used to track the size of a file. This eliminates the need for additional variables. To sequentially read ten records from a random file, NRN may be used as the record number variable.

```
200 FOR X=1 TO 10
210 GET 1, (NRN1)
220 C$(X)=A$ : D$(X)=B$
230 NEXT
```

The purpose of the array variables C\$(X) and D\$(X) is to move the data out of the file buffer *before* the next record is read. If this is not done, the next record will overwrite the previous one.

If the intent of reading the file is merely to PRINT the contents of the file, we can substitute:

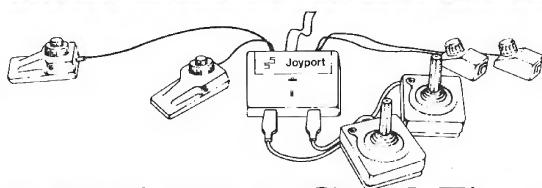
220 PRINT A\$ : PRINT B\$

for line 220 in the example. This will print each record and then overwrite the data with the next record. Hence, we can read an entire random access file, print it, and only use 128 bytes of variable space. No problem with unexpected garbage collections here!

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# A Sequential File Handler for a Disk-Based OSI

by Mark Johnson and Chris Johnson

**An easily implemented sequential file handler for the C1P, written in BASIC, that may be adapted to the OSI C2 and C3 under OS65D3.2. Structured programming is used to provide a control program that calls subroutines for speed and efficiency.**

These routines require:

OSI C1P  
DOS OS65D3.2

They may be modified for C2 and C3 models.

The most significant criteria distinguishing professional machines from toys is the ability to handle files. OSI offers OS65U operating system for its professional machines, but the operating system is not available for the C1P. OS65D, the operating system for the C1P, supposedly has file handling capabilities, but is severely limited in several ways. The search routine employed by OS65D to look for the beginning of a new record is very inefficient and slow. In OS65D, files are placed in fixed-length records of 128 bytes. Even a record of only one byte takes up 128 bytes on the disk. This system is very inefficient for short records and also severely limits the use of long records.

OS65D doesn't keep track of the number of records used in a file. A program counter must be implemented to count records from the beginning of the file until an End-Of-File marker is read. Large amounts of time are consumed every time the counter program is used. Also the OS65U on the C1P consumes 22K of RAM and costs \$200.00. Machine-language subroutines are difficult to access from BASIC, and are not easily modified.

The requirements for a good file handler established the following criteria:

1. The file handler must be written entirely in BASIC.
2. It must be fast in operation.
3. Variable length records must be allowed.
4. It must be easy to use.
5. The SAVE and LOAD functions should be written as subroutines so that they may be easily accessed from the calling program.

The program evolved into a General Initialization Routine (listing 2), a SAVE and LOAD Initialization Routine (listing 3), a SAVE Routine (listing 4), and a LOAD Routine (listing 5). Listing 1 is a sample control program to show how a typical calling program would operate, and is the basis of a simple text editor. Listing 6 is a sample run of the program.

## General Initialization Routine (Listing 2)

The REM statements, lines 60000 through 60090, make the program self-explanatory and may be removed to conserve memory. Variable PK is set to 2K less than your memory size to allow 2K workspace at the top of memory. The POKE statements on lines 60110 and 60120 set BASIC's top of memory to the new memory size. The variable REC is used as a record counter and is initialized by line 60130. Note that the General Initialization Routine is a subroutine called by the control program each time a new track is to be initialized.

## SAVE and LOAD Initialization Routines (Listing 3)

The SAVE initialization is contained in lines 61000 through 61040 and is called once by the control program when a SAVE is made. It is used to write header information that the track has been used by the program. Line

61020 initializes the REC counter, and line 61040 advances the counter to the correct count to start adding records to the track.

The LOAD initialization is contained in lines 63000 through 63020 and is called once by the control program when a LOAD is made. Line 63020 sets a data pointer to the header on the track.

## SAVE Routine (Listing 4)

Lines 62000 to 62250 comprise the SAVE routine. It is a subroutine that is called by the control program each time a line of data (up to 254 bytes) is to be saved on disk. Line 62050 increments the record counter, RC. Lines 62060 through 62205 detect a full track condition and allow data to be written on the next succeeding track, if desired. If "NO" is selected as an option to writing on the next track, then all data are killed. Lines 62210 through 62250 save the data into the track buffer, write a "0" as the last byte as an End-Of-Record flag, and reset the REC location pointer to the proper record number.

Lines 63500 through 63570 comprise the LOAD subroutine. It is called by the control program each time a record is to be loaded from the track buffer into string RC\$. Lines 63500 through 63530 increment the record counter, RC, and check to see if the value of RC exceeds the number of records on the track. If so, RC\$ is set to a null string and return is made to the control program. If the character is not an End-Of-Record symbol, return is then made to the control program with RC\$ holding a line of data.

## Control Program (Listing 1)

The sample control program shown in lines 10 through 440 is included to show the function of the previously described subroutines. It may be modified as desired. The subroutines are universal for almost any file-manipulation technique. The control

**Listing 1: Control Program**

```

10 GOSUB6000:PRINT"MENU:";:GOSUB130:RC=0
20 PRINT" S) SAVE DATA ONTO A TRACK, "
30 PRINT" L) LOAD DATA FROM A TRACK, "
40 PRINT" Q) QUIT."
50 POKE2797,58:POKE9682,161:POKE2868,0:POKE8722,0:
   POKE2976,13
60 POKE2972,13
70 INPUT"CHOICE":C$:C$=LEFT$(C$,1)
80 IFC$="S"THEN190
90 IFC$="L"THEN290
100 IFC$="Q"THENPOKE2972,44:POKE2976,58:END
110 PRINT"INVALID OPTION."
120 GOTO70
130 P1=INT(PK/4096)
140 P2=INT((PK-(P1*4096))/256)
150 P3=INT((PK-((P1*4096)+(P2*256)))/16)
160 P4=PK-((P1*4096)+(P2*256)+(P3*16))
170 P$=CHR$(48+P1):IFP2>9THENP$=P$+CHR$(55+P2):
   GOT0172
171 P$=P$+CHR$(48+P2)
172 IFP3>9THENP$=P$+CHR$(55+P3):GOT0174
173 P$=P$+CHR$(48+P3)
174 IFP4>9THENP$=P$+CHR$(55+P4):GOT0176
175 P$=P$+CHR$(48+P4)
176 RETURN
180 REM SAVE & LOAD CONTROL ROUTINES
190 GOSUB268:GOSUB61000
200 PRINT"ENTER DATA:"
210 INPUTRC$:
220 IFRC$=""THEN250
230 GOSUB62000
240 GOTO210
250 DISK!"SA "+TR$+",1="+P$+"/8":GOT010
260 INPUT"TRACK TO BE USED":TR$:
270 IFVAL(TR$)<160RVAL(TR$)>39THEN260
280 RETURN
290 GOSUB268:GOSUB63000
300 DISK!"CA "+P$+"=+TR$+",1"
310 IFPEEK(PK)=161THEN340
320 PRINT"**TRACK NOT FORMATTED      (NOT USED)."
330 GOT010
340 IFPEEK(PK+1)>0THEN370
350 PRINT"**TRACK EMPTY."
360 GOT010
370 PK=PK+2
380 PRINT"TRACK: "TR$:
390 FORX=1TOPEEK(REC)
400 GOSUB63500
410 PRINTRC:TAB(5):RC$:
420 NEXTX
430 PRINT"**END OF DATA."
440 GOT010

```

**Listing 2: General Initialization Routine**

```

60000 REM SET UP MEMORY SIZE
60010 REM AND VARIABLE 'PK'.
60020 REM IF YOU HAVE A
60030 REM DIFFERENT MEMORY
60040 REM SIZE THAN 32K.
60050 REM CHANGE THE NUMBER 'PK'
60060 REM TO YOUR MEMORY
60070 REM (EX:16K), THEN
60080 REM SUBTRACT 2K
60090 REM (EX:14K).
60100 PK=30*1024
60110 POKE133,INT(PK/256)
60120 POKE132,PK-(INT(PK/256)*256)
60130 REC=PK+2
60140 RETURN

```

**Listing 3: SAVE and LOAD Initialization Routines**

```

61000 REM SAVE INITIALIZATION
61010 REM SUBROUTINE
61020 POKEPK+1,161
61030 POKEPK+2,0
61040 PK=PK+3:RETURN
63000 REM LOAD INITIALIZATION
63010 REM SUBROUTINE
63020 PK=PK+1:RETURN

```

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**Listing 4: SAVE Routine**

```

62000 REM SAVE ONE LINE
62010 REM OF STRING ONTO
62020 REM TRACK BUFFER.
62030 REM UPDATE RECORD
62040 REM COUNTER.
62050 RC=RC+1
62060 IFRC>256THEN62210
62070 PRINT"**YOU HAVE OVER 255
   LINES ON THIS TRACK."
62080 PRINT" DO YOU WISH TO SAVE
   THIS TRACK AND"
62090 PRINT" CONTINUE ON THE NEXT ONE";
62100 POKE2797,58
62110 INPUTA$:POKE2797,58
62120 IFLEFT$(A$,1)=="Y"THEN62150
62130 GOT010
62140 REM READY NEXT TRACK FOR INFORMATION
62150 DISK!"SA "+TR$+",1="+P$+"/8"
62160 TR=VAL(TR$)+1:IFTR>39THEN62200
62170 TR$=RIGHT$(STR$(TR$),2)
62180 GOSUB60000:GOSUB61000
62190 GOT062210
62200 PRINT"**YOU'RE AT THE END OF
   THE DISK, THE LINE"
62205 PRINT" YOU HAVE JUST TYPED
   IS LOST, SORRY!!":END
62210 FORX=1TOLEN(TR$)
62220 POKEX+PK-1,ASC(MID$(TR$,X,1))
62230 NEXTX:PK=PK+X
62240 POKEPK-1,0:POKERECD,RC
62250 RETURN

```

program is all that needs to be changed to develop a field-oriented data base management system or a full text editor. These control programs will be presented in following issues.

Lines 10 through 40 call the General Initialization Routine, translate the decimal memory size to hexadecimal for use by OS65D subroutines, initialize record counter RC, and list a menu of choices. Lines 50 through 60 remove some limitations on BASIC that prevent use of commas and colons in text and allow a carriage return as a valid input. (See the listing of POKE values for a detailed description.) Lines 70 through 120 direct program control to the proper subroutine, depending on the menu choice.

Lines 180 through 280 form a control program for the SAVE function. It asks for the desired track number to start data storage. Note that tracks 1 through 15 are blocked because this is where OS65D and the DOS reside. Tracks greater than 39 are also blocked because the C1P drive is a 40-track drive. These restrictions may be altered by changing the parameters in line 270. The SAVE initialization and SAVE subroutines are called by the control block.

Lines 290 through 440 form the LOAD control program. It asks for the desired track number to start data retrieval from disk. The track number restrictions indicated in the SAVE control program also apply. These restrictions are automatically altered if the SAVE control program parameters in line 270 are changed. The LOAD control program loads the desired track into the track formatting. The track is next checked to see whether or not it contains data. Each record is printed, one at a time, along with its record number.

### Sample Run (Listing 6)

The MENU is printed and choices are given to:

S) SAVE data onto a track,  
L) LOAD data from a track,  
Q) QUIT (Exit to BASIC).

If a SAVE or LOAD is selected, the user is asked for the desired track number. The sample run shows selection of SAVE, entry of data, selection of LOAD, retrieval of the data, and exit to BASIC.

### POKE Locations and Their Purposes

POKE 2797, 58 changes the question mark used on INPUT to a colon.

POKE 9682, 161 changes the cursor symbol to a block.

POKE 2888, 0 and POKE 8722, 0 must be made in conjunction to allow null inputs (carriage return only) without automatic exit into BASIC.

POKE 2976, 13 allows entry of a comma as part of an INPUT.

POKE 2972, 13 allows entry of a colon as part of an INPUT.

POKE 133, INT(PK/256) and POKE 132, PK - [INT(PK/256)\*256] are the high and low bytes defining the top of memory.

### Variables

RC	Record counter — used to keep track of present record number.
C\$	Temporary input storage.
P1-P4	Temporary storage for decimal/hexadecimal conversion.
P\$	Hexadecimal value of beginning of track storage area.
RC\$	Temporary storage area for data in a record.
TR\$	Selected track number.
PK	Pointer to present location in track storage area.
X	Iteration counter.
REC	Storage location for total number of records in use.
A\$	Temporary input storage.
TR	Temporary track number storage.
P	Temporary storage present character.

### Listing 5: LOAD Routine

```
63500 REM LOAD ONE LINE INTO
63510 REM STRING "RC$".
63520 RC=RC+1:RC$=""
63530 IF RC>PEEK(REC)
THEN RC$="":RETURN
63540 P=PEEK(PK)
63550 IF P=0 THEN PK=PK+1:RETURN
63560 RC$=RC$+CHR$(P)
63570 PK=PK+1:GOT063540
```

### Listing 6: Sample Run

```
MENU:
S) SAVE DATA ONTO A TRACK,
L) LOAD DATA FROM A TRACK,
Q) QUIT.
CHOICE: S
TRACK TO BE USED: 32
ENTER DATA:
: NOW IS THE TIME FOR
: ALL GOOD MEN TO COME
: TO THE AID OF THEIR
: COUNTRY.
:
MENU:
S) SAVE DATA ONTO A TRACK,
L) LOAD DATA FROM A TRACK,
Q) QUIT.
CHOICE: L
TRACK TO BE USED: 32
TRACK:32
1 NOW IS THE TIME FOR
2 ALL GOOD MEN TO COME
3 TO THE AID OF THEIR
4 COUNTRY.
**END OF DATA.
MENU:
S) SAVE DATA ONTO A TRACK,
L) LOAD DATA FROM A TRACK,
Q) QUIT.
CHOICE: Q
```

OK

Chris Johnson is employed by Westinghouse Electric Corporation as an applications engineer for a line of microprocessor-based programmable controllers. He learned FORTRAN in 1960, but currently uses BASIC and 6502 machine language. He has been involved in solid state design since 1956.

Mark Johnson is sixteen years old and has been writing BASIC programs for the past five years. He is conversant in 6502 assembler, COBOL, FORTRAN, ALGOL, and Pascal.

Mark and Chris work as a team, with Mark specializing in software and Chris specializing in hardware. They currently have a homebrew, an extensively modified OSI C1P, and an Atari. They are presently investigating high-resolution color graphics and a new homebrew — based on either the 6809 or the 68000. They may be contacted at 7204 S. Yarrow St., Littleton, CO 80123.

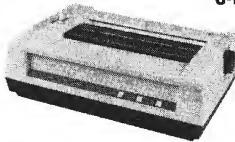
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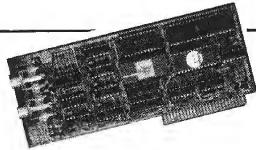
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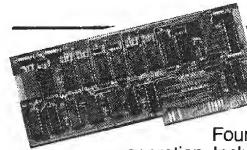
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```
100 GOSUB 180
105 PRINT USING CS, A, B$ 
130 INPUT "TIME", DS
131 INPUT "DAY", ES
160 IF B<>C THEN 105
180 FOR X=1TO9
183 PRINT Y(X):NEXT
184 RETURN
200 I=X/19
READY
RENUMBER 110, 10, 105-184
READY
LIST
100 GOSUB 150
110 PRINT USING CS, A, B$ 
120 INPUT "TIME", DS
130 INPUT "DAY", ES
140 IF B<>C THEN 110
150 FOR X=1TO9
160 PRINT Y(X):NEXT
170 RETURN
200 I=X/19
READY
```

```
MERGE D1 "BUY NOW"
SEARCHING FOR BUY NOW*
LOADING
READY
RENUMBER 100, 10
READY
FIND B$*
110 PRINT USING A$, B$, C$ - DS
280 B$*="NOW IS THE TIME"
READY
```

```
580 BA=BA-1
590 RA=123*SX/92+BA*10
600 IF BA=143 THEN 580
610 RETURN
620 CS="PROFIT $#,###.## DAILY"
630 PRINT USING CS, PI
640 DS="LOSS $#,###.## DAILY"
650 PRINT USING DS, LI
RUN
PROFIT $1, 238.61 DAILY
LOSS $ 0.00 DAILY
READY
```

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# Face Synthesizer for PET

by David Heise

**This program creates an animated face on a PET screen that changes expression on keyboard command. Animation is controlled from BASIC programs, so the PET face can be used in any application — education, marketing, games, etc.**

## Face Synthesizer requires:

PET  
8K or larger  
3.0 or 4.0 Operating System

Facial expressions reflect emotions. This well-known fact has been a topic of study for social psychologists, who analyze expressions by observing the shape and position of eyes, mouth, eyebrows, and other facial features. The psychologists' precise technical descriptions of these features provided me with the data I needed to represent facial expressions on a computer. Now your PET can express emotions too.

This program generates a face that smiles, winks, and pouts; shows fear, disgust, or anger; or widens its eyes in surprise. You operate the face from the keyboard. The facial expressions also can be called from BASIC programs for practical applications. A salesroom display program could use the PET face to call attention to a product with moving eyes, winks, and smiles. Education programs could use the face to provide rewards or reproofs for right or wrong answers.

## What Are Facial Expressions?

Emotional messages are constructed on the face by the shape of the mouth, eyes, and eyebrows (and sometimes the nose, cheeks, and forehead as well). Each of these features has a limited number of major shapes produced by the action of certain facial

muscles. Whether a group of muscles is tugging gently or straining hard may suggest the intensity of feeling, but the real information is in the fact that certain muscles are operative, producing the characteristic shape for that muscle group.

The brows have four major shapes other than a neutral relaxed position. They may be curved upward (as in surprise), flattened and raised (as in fear), flattened and lowered (as in sadness), or pulled down and inward (as in anger).

The opened eyes have six major shapes: neutral, wide open (as in surprise), raised lower lids (as in disgust), raised and tensed lower lids (as in fear), squinting (as in anger), and upper lids drooping and sloped (as in sadness).

Major shapes of the mouth, aside from neutral, are: dropped open (as in surprise), corners pulled horizontal (as in fear), lips pressed tight (as in anger), squared outthrust lips baring teeth (as in anger), upper lip pulled up (as in disgust), corners down (as in sadness), corners raised (as in happiness, with extra stretching for smiles, grins, or laughs).

The end of the nose may be normal or raised by pressure from the upper lip; the upper nose may be normal or crinkled. Cheeks may be normal or raised during laughter. The forehead may be normal or wrinkled by pressures from the eyebrows.

Variations in one feature combine with variations in another feature; for example, any eyebrow formation can occur with any mouth shape. But not quite every combination of features is possible. For example, the mouth isn't disgusted alone; "disgusted" mouth occurs with nose raised.

Expressions for the primary emotions are universal. Surprise combines arched eyebrows with wide open eyes and a dropped open mouth. Fear shows in raised and flattened eyebrows, raised

and tensed lower eyelids, along with sidestretched lips. Disgust involves raised lower eyelids, and the upper lip curled up so to raise the nose; the upper nose may be crinkled. In anger the brows pull down and inward, the eyes squint, and the lips either are pressed tight or squared into a snarl. Happiness is revealed in upturned corners of the mouth; laughing also raises the cheeks which in turn may push the lower eyelids up.

Blends can be formed by combining signs of two emotions. For example, arched eyebrows and a smile indicate surprised happiness. Subtle feelings also may be communicated by rapid sequences of expressions — an angry expression interrupted by a flash of disgust.

## The Face Program

The face synthesizer presented here consists of 2K of assembly-language code designed to run on 32K PET/CBM microcomputers with 40-column screens. Instructions are given on relocating the code for 16K or 8K machines. The synthesizer does not work with Commodore operating system 1.0, and it produces a long and narrow face on 80-column screens.

The facial image was created by tracing a photo of a woman's face in a magazine onto graph paper, and then matching features in each cell as closely as possible with Commodore graphics. The happy, grinning face that appears by default is the original. Feature variations were created artistically, with guidance from photographs of facial expressions. Gaze variations were constructed so that the face can be made to look forward, left, right, or down. Left and right eyelids can be independently controlled for winks, blinks, and closed eyes.

The program includes limited feature variations. Each feature shape is represented in a single form, though

## APPLICATIONS

real faces can produce gradations. Some eye variations are too subtle for Commodore graphics, so a single approximate shape has to serve multiple duty. Nose crinkling for disgust and raised cheeks for laughter are not included. No asymmetric moves for brows or mouth are included.

Paul Ekman and Wallace Friesen's book, *Unmasking the Face* (Prentice-Hall, 1975), guided composition of the feature variations. This paperback is an essential manual for anyone using the face program in application programming.

## The Emotional Keyboard

Running the programs listed here produces the PET face and an initial display of some of its expressive variations. After the opening show, you can produce new expressions from the keyboard. Each feature variation is linked to a single key. The brow is controlled by keys in the top row of the keyboard. Eyes and eyelids are controlled by keys in the next two rows, with left eye variations on the left and right eye variations on the right. The mouth is controlled by keys in the bottom row. The six basic emotion configurations are available from single keys — parentheses, brackets, and inequalities. The number keys control compositions that are needed in programming. Chart 1 indexes command characters and their effects.

The demonstration program allows you to construct a string of commands that can produce an animated sequence of expressions. To begin a string, press the "+" key. When you have completed the sequence and are ready to view it, press the "=" key. Use the delay command (shifted SPACE) between different expressions so that the sequence runs slow enough for you to see. You may press the "\*" key to see the last sequence again. If you press the "/" key, the commands producing the last sequence are printed on the screen and the program ends. Use this option to work out desired effects before entering commands into your BASIC program.

## Faces in BASIC

Listing 1 presents the demonstration program that illustrates all of the points essential to using the Face routine with BASIC. Commands are sent to the routine via a string variable named FACE\$ (or FA\$) (this must be defined in the program before calling the Face routine or you will get an error). The FACE\$ string may be con-

### **Listing 1**

## **Listing 2**

```
100 : REM: LOADER PROGRAM
110 :
120 : REM: ROUTINE TO LOAD THE ASSEMBLED CODE, THEN THE MAIN PROGRAM.
130 : REM: DELETE NEXT LINE TO LOAD FROM TAPE, INCLUDE IT TO LOAD FROM DISK.
140 DV$="#,8"
150 : REM: SET GRAPHICS MODE.
160 POKE 59468,12
170 : REM: STORE 4 CARRIAGE RETURNS IN INPUT BUFFER,
180 POKE 158,4:POKE 623,13:POKE 624,13:POKE 625,13:POKE 626,13
190 : REM: SET UP SCREEN TO INVOKE THE SUBROUTINE FILE -- 'CODE',
200 : REM: "<s>" IS CLEAR SCREEN. "<Q>" IS CURSOR DOWN.
210 IF DV$<>#,8" THEN DV$="#,8"
220 PRINT "<Q><Q><Q>LOAD" CHR$(34)"CODE" CHR$(34)DV$:PRINT "<Q><Q><Q>SYS 30720"
230 : REM: THEN LOAD PROGRAM 'MAIN'
240 PRINT "<Q><Q>LOAD" CHR$(34)"MAIN" CHR$(34)DV$"
250 : REM: "<s>" IS CURSOR HOME.
260 PRINT "<Q><Q><Q><Q>RUNS>";END
```

structed by direct quotes; by GET, INPUT, or READ statements; or by string manipulations.

The first string sent to the routine should begin with "01234". These five commands display the face on the screen. Thereafter the FACE\$ string consists only of commands for desired feature changes.

Commands in the FACE\$ string are implemented by SYS 30729 on a 32K PET, SYS 14345 on a 16K PET, or SYS 6153 on an 8K PET.

Listing 2 is a BASIC utility program that automatically loads the Face code from a file named CODE, protects the code from BASIC, and then loads another BASIC program named MAIN. Program MAIN would be listing 1 when you set up the demonstration procedure; otherwise it is the application program you have written. On tape, the Loader program should be first, the CODE file second, and MAIN third. On

disk, the order is immaterial, but the names CODE and MAIN are required. (The DOS wedge can be loaded after the face routines are loaded.)

## Assembly-Language Routine

Listing 3 is the assembly-language routine. Listing 4 contains the data used to compose the face and its variations on the screen.

You enter the code in listings 3 and 4 with the PET/CBM monitor (SYS 1024). To begin enter:

.M 7800,787F

Then overwrite the contents of the cells with the hexadecimal values at the left of listing 3, pressing RETURN after each line. Continue with:

.M 7880,7900

and so on. When you have finished

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- 4-Pass compiler.
- Automatically uses faster integer arithmetic when possible.
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- Subroutines no longer need be located at the beginning of your program.
- Petspeed automatically calls all subroutines at maximum speed.
- Petspeed runs twice as fast as other compilers.
- Larger programs require far less memory when compiled.

**Easy to Use** Petspeed is as easy to use as these screen displays illustrate.

```
*** COMMODORE BASIC 4.0 ***
31749 bytes free
ready.
directory dl
1 "petspeed" 75 20
2 "your program" prg
361 blocks free.
ready.
```

Directory BEFORE compilation.

```
PETSPED
PROGRAM NAME : YOUR PROGRAM
ISSUE 2.0 (C) 6/15/82
```

Simply type in your program name.

```
*** COMMODORE BASIC 4.0 ***
31749 bytes free
ready.
201
1 "petspeed" 75 20
2 "your program" prg
3 "your programgt" prg
4 "your program.w" prg
1779 blocks free.
1692.
ready.
```

Directory AFTER compilation

**Security** A security device is provided to run Petspeed, but no runtime key is necessary for compiled programs. You're free to build in your own protection. Petspeed code cannot be listed by others, so compiled programs cannot be tampered with. Your programs belong entirely to you.

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## APPLICATIONS

with the data in listing 3, go on to listing 4. Print out lines of memory the same as they appear in listing 4 to simplify entry.

When all code has been entered, save it on tape with:

.S "CODE",01,7800,7FF2

or on a preinitialized disk in unit 0 with:

.S "0:CODE",08,7800,7FF2

If you are saving on tape, remember to save the Loader program (listing 2) on the tape before you begin to enter the code in listings 3 and 4.

To relocate the code for a 16K machine, change all \$7000 addresses to \$3000 addresses. For example, you would begin entering code with:

.M 3800,387F

Some addresses within the program have to be changed. Relevant lines are flagged by <SIZE> in the comments column. Change the 7 in the address high byte to 3 wherever <SIZE> appears. For example, A9 77 in line 440 would become A9 37. In addition, the last byte of each entry in the INDEX must be changed (the INDEX begins at line 2080). For example, 79 in the SCALP entry would be changed to 39, 7A in the BROW entry becomes 3A, etc.

Relocation for 8K is similar except that sevens are changed to ones.

The address in line 1890 of listing 3 is for operating system 3.0. Change 69 C3 to 00 BF for operating system 4.0.

The data in listing 4 remain the same for all machines.

### Program Notes

Lines 70-100 in listing 3 are instructions for the assembler program.

Lines 140-210 indicate parts of the PET/CBM operating system that are used in the Face program.

Lines 240-350 show the locations in screen memory where facial features begin.

Lines 420-460 are a short routine for putting the Face code outside the bounds of BASIC. This routine is called by the Loader program in listing 2 immediately after loading the Face code.

The Face program begins in line 540. First the FACE\$ command string has to be found (lines 540-590 plus the subroutine in lines 1630-2030).

Commands in the FACE\$ string are transferred to the stack in reverse order (lines 620-670), after a zero is pushed on the stack to signal the end of the commands (lines 600-610).

Commands are retrieved from the stack by the routine in lines 700-740. If a zero is encountered, then all commands have been processed and control returns to BASIC. If the command value is negative (greater than 127), then the routine drops into a dummy loop that causes a delay. A shifted space has ASCII value 160 so it causes a delay. Otherwise control shifts to line 850, and a search is initiated to find the command in the Index (lines 850-940). If the command is not found, it is ignored, and the program branches to get the next command from the stack.

When a command to change a feature is found, lines 950-990 transfer the screen pointer for the relevant feature to cells in the floating point accumulator (FACC serves as free zero-page memory for this routine). Then lines 1000-1080 set up a short subroutine in FACC to fetch bytes from the stored data. The screen pointer and the pointer to the stored data both are obtained from the Index entry for the command being implemented.

Lines 1110-1150 get a byte from the stored data and set indexes for current use. The data byte is tested in lines 1160-1210 to see if it is an ordinary datum or a special subcommand.

If the byte is zero, it means that all data have been transferred, and control branches to get the next Face command. Values one, two, and three, are special subcommands used to reduce the amount of space needed for data.

Value one is a skip command. The byte following is fetched to determine how many screen cells to skip, and then the screen pointer is adjusted to accomplish this (lines 1330-1400).

Value two is a duplicate command. The byte following the two is fetched to define the character to be duplicated. The byte after that is fetched to determine how many times the character is to be displayed. Then the character is put on the screen the required number of times (lines 1420-1580).

Value three causes a feature manipulation to be appended after the cur-

rent one. The byte following the three is fetched and pushed on the stack. Thus it will be the next Face command to be implemented (lines 1250-1270).

If the data byte is not zero, one, two, or three, then it is a character byte, and it is transferred directly to the screen (lines 1300-1310). Processing of data bytes continues in a loop until a zero value is found.

The subroutine in lines 1630-2030 searches the BASIC variable list for the FACE\$ string. When it is found, the pointer to the string and the string's length are saved for use in the main program. If FA\$ is not found, the procedure aborts via the BASIC error routine.

The Index shows the ASCII value for each command character, the place on the screen where the relevant feature begins, and the point in memory (listing 4) where data for that command are stored.

Chart 1	
Keyboard Character	Effect on Face
<i>Complete face</i>	
{	Happiness
}	Sadness
[	Fear
]	Anger
<	Disgust
>	Surprise
<i>Eyebrows</i>	
&	Normal
\	Arched high
%	Flat, lowered
#	Flat, raised
\$	Furrowed down
<i>Eyes</i>	
T	Normal, gaze forward
I	Normal, gaze down
W	Normal, gaze left
O	Normal, gaze right
E	Lids drooping, gaze forward
Y	Lids high, gaze forward
R	Lids high, gaze downward
U	Lids down, gaze forward
Q	Lids down, gaze left
P	Lids down, gaze right
S	Left eye closed
K	Right eye closed
A	Left eye tense closed
L	Right eye tense closed
<i>Mouth</i>	
X	Normal
?	Smiling
Z	Grinning
B	Saddened
V	Frightened
C	Disgusted
N	Dropped open
M	Opened showing teeth
,	Lips pressed tight
<i>Other</i>	
Shift Space	Brief delay
01234	Construct grinning face
5	Chin up
6	Chin down
7	Nose normal
9	Nose up

Listing 3

```

0010 ; ****
0020 ; # * *
0030 ; # FACE * *
0040 ; # * *
0050 ; ****
0060 ; 070 START .BA 30720 ;PLACE WHERE CODE BEGINS WHEN
0070 ; USED.
0080 ; .MC $7800 ;PLACE WHERE CODE ASSEMBLES.
0090 .OS ; ;CREATE CODE.
0100 ;
0120 ;
0130 .DE $C369 ;ERROR ROUTINE ($EF00 IN O.S.
0140 OUT 4.c)
0150 ;
0160 .DE 42 ;ZERO-PAGE USAGE
0170 PTR .DE 44 ;BEGINNING OF VARIABLES
0180 LIM .DE 44 ;END OF VARIABLES
0190 RAM .DE 52 ;LOCATION FOR HIGHEST RAM
0200 NAME .DE 66 ;VARIABLE NAME
0210 FACC .DE 94 ;FLOATING POINT ACCUMULATOR
0220 ;
0230 ; SCREEN VARIABLES
0240 ROW .DE #0
0250 SCALP# .DE 32768
0260 BROW# .DE 32968
0270 MIDFACE# .DE 33168
0280 CHEEKS# .DE 33368
0290 NECK# .DE 33568
0300 BROW$# .DE 33059
0310 EYES# .DE 33140
0320 R\EYES# .DE 33150
0330 NOSE# .DE 33344
0340 MOUTH# .DE 33463
0350 CHIN# .DE 33620
0360 ;
0370 ; ****
0380 ; SYS 30720 FOR 32K,
0390 ; 14336 FOR 16K,
0400 ; 6144 FOR 8K.
0410 ; PROTECT SUBS FROM BASIC.
7800- A9 FF 0420 INVOKE LDA #L,INVOKE-1
7802- 85 34 0430 STA *RAM
7804- A9 77 0440 LDA #B,INVOKE-1 ;<SIZE>
7806- 85 35 0450 STA *RAM+1
7808- 60 0460 RTS
0470 ;
0480 ;
0490 ; SYS 30729 FOR 32K,
0500 ; 14345 FOR 16K,
0510 ; 6153 FOR 8K.
0520 ;
0530 ; STACK THE SET OF COMMANDS.
7809- A9 46 0540 FACE LDA #'F' ;FIND THE FACE$ VARIABLE.
780B- 85 42 0550 STA *NAME
780D- A9 41 0560 LDA #'A'
780F- 09 80 0570 ORA #128
0580 STA *NAME+1
7811- 85 43 0590 JSR FIND ;<SIZE>
7812- 20 AB 78 0600 LDA #0 ;END COMMANDS WITH A 0.
7816- A9 00 0610 PHA
7818- 48 0620 LDY #FACC ;GET LENGTH OF COMMAND STRING.
7819- A4 5E 0630 STORE LDA (NAME),Y
781B- B1 42 0640 PHA ;PUT COMMANDS ON STACK IN REVERSE ORDER.
781E- 88 0650 DEY
781F- C0 FF 0660 CPY #255
7821- DO F8 0670 BNE STORE
0680 ;
0690 ; IMPLEMENT THE COMMANDS.
7823- A2 00 0700 PRINT LDX #0 ;GET THE NEXT COMMAND.
7825- 68 0710 PLA
7826- 30 03 0720 BMI TIME
7826- 00 0D 0730 BNE SEARCH
782A- 60 0740 RTS ;DONE IF ZERO.
782B- A2 60 0750 TIME LDX #96 ;SHIFTED SPACE CAUSES DELAY.
782D- A0 00 0760 LDY #0
782F- 88 0770 DELAY DEY
7830- D0 FD 0780 BNE DELAY
7832- CA 0790 DEY
7833- D0 FA 0800 BNE DELAY
7835- F0 EC 0810 BEQ PRINT
0820 ;
0830 ; PREPARE FOR DATA TRANSFER.
0840 ; ;FIND THE POINTERS FOR THE COMMAND.
7837- DD F7 78 0850 SEARCH CMP INDEX,X ;<SIZE>
783A- F0 0B 0860 BEQ DUMP
783C- E8 0870 INX
783D- E8 0880 INX
783E- E8 0890 INX
783F- E8 0900 INX
7840- E8 0910 INX
7841- E0 D7 0920 CPX #INDEX\SIZE
7843- D0 F2 0930 BNE SEARCH
7845- F0 DC 0940 BEQ PRINT ;NOT FOUND--GO TO NEXT COMMAND.

```

Listing 3 (Continued)

```

7847- E8 0950 DUMP INX ;SET UP SCREEN POINTER IN FACC.
7848- BD F7 78 0960 LDA INDEX,X ;<SIZE>
784B- 85 5E 0970 STA *FACC
784D- BD F8 78 0980 LDA INDEX+1,X ;<SIZE>
7850- 65 5F 0990 STA *FACC+1
7852- A9 BD 1000 LDA #$BD ;STORE LDA,X IN FACC.
7854- 85 60 1010 STA *FACC+2
1020 ; ;SET UP DATA POINTER IN FACC.
7856- BD F9 78 1030 LDA INDEX+2,X ;<SIZE>
7859- 85 61 1040 STA *FACC+3
785B- BD FA 78 1050 LDA INDEX+3,X ;<SIZE>
785E- 85 62 1060 STA *FACC+4
7860- A9 60 1070 LDA #$60 ;STORE RTS IN FACC.
7862- 85 63 1080 STA *FACC+5
1090 ;
1100 ; GO THROUGH DATA.
7864- A0 FF 1110 LDY #255 LDX #255
7866- A2 FF 1120
7868- C8 1130 GETONE1 INY
7869- E8 1140 GETONE2 INX
786A- 20 60 00 1150 JSR FACC+2
786D- F0 B4 1160 BEQ PRINT ;CODE=0 IS END: DO NEXT COMMAND.
786F- C9 02 1170 CMP #2
7871- 90 11 1180 BCC SKIPON ;CODE=1 MEANS SKIP CELLS.
7873- F0 1E 1190 BEQ REPEAT ;CODE=2 MEANS REPEAT BYTE.
7875- C9 03 1200 CMP #3
7877- D0 07 1210 BNE TRANSFER
7879- E8 1220 INX ; ;CODE=3 MEANS APPEND.
1230 ;
1240 ; ;FOR APPEND:
787A- 20 60 00 1250 JSR FACC+2 ;GET COMMAND
787D- 48 1260 PHA ; ;AND PUSH ON STACK.
787E- D0 E9 1270 BNE GETONE2
1280 ; ;FOR NORMAL BYTE:
1290 ; ;PUT IT ON SCREEN.
7880- 91 5E 1300 TRANSFER STA (FACC),Y
7882- D0 E4 1310 BNE GETONE1
1320 ; ;FOR SKIP:
7884- E8 1330 SKIPON INX ; ;FIND NUMBER OF CELLS TO SKIP
7885- 20 60 00 1340 JSR FACC+2
7888- 18 1350 CLC ; ;AND ADD TO THE SCREEN POINTER.
7889- 65 5E 1360 ADC *FACC
788B- 85 5E 1370 STA *FACC
788D- 90 D4 1380 BCC GETONE2
788F- E6 5F 1390 INC *FACC+1
7891- B0 D6 1400 BCS GETONE2
1410 ; ;FOR REPEAT:
7893- E8 1420 REPEAT INX ; ;GET THE CHARACTER
7894- 20 60 00 1430 JSR FACC+2
7897- 48 1440 PHA
7898- E8 1450 INX ; ;AND THE NUMBER OF REPEATS.
7899- 86 64 1460 STX *FACC+6 ;(REMEMBER THE CURRENT DATA INDEX.)
789B- 20 60 00 1470 JSR FACC+2
789E- AA 1480 TAX
789F- 68 1490 PLA
1500 ; ;PUT THE CHARACTER ON THE SCREEN
78A0- 91 5E 1510 ZIP STA (FACC),Y
78A2- C8 1520 INY
78A3- D0 02 1530 BNE CONT
78A5- E6 5F 1540 INC *FACC+1
78A7- CA 1550 CONT DEX
78A8- D0 F6 1560 BNE ZIP ;REPEATEDLY,
78AA- A6 64 1570 LDX *FACC+6 ;RECOVER INDEX
78AC- D0 BB 1580 BNE GETONE2 ;TO CONTINUE WITH DATA.
1600 ;
1610 ;
1620 ; ;FIND VARIABLE IN BASIC LIST
78AE- A5 2A 1630 PIND LDA *PTR ;SAVE TABLE POINTER.
78B0- 48 1640 PHA
78B1- A5 2B 1650 LDA *PTR+1
78B3- 48 1660 PHA
78B4- A0 00 1670 CHECK LDY #0 ;COMPARE NAME IN VARIABLE TABLE
78B6- B1 2A 1680 LDA (PTR),Y
78B8- C5 42 1690 CMP *NAME ;WITH CRITERION NAME.
78BA- D0 08 1700 BNE AGAIN2
78BC- C8 1710 INY
78BD- B1 2A 1720 LDA (PTR),Y
78BF- C5 43 1730 CMP *NAME+1
78C1- F0 1D 1740 BEQ POINT ;IF NO MATCH, THEN
78C3- 88 1750 DEY
78C4- A9 07 1760 AGAIN2 LDA #7 ;GET POSITION OF NEXT VARIABLE
78C6- 18 1770 CLC
78C7- 65 2A 1780 ADC *PTR
78C9- 85 2A 1790 STA *PTR
78C8- A9 00 1800 LDA #0
78CD- 65 2B 1810 ADC *PTR+1
78CF- 85 2B 1820 STA *PTR+1
78D1- C5 2B 1830 CMP *LIM+1 ;IF NOT END OF VARIABLES
78D3- D0 DF 1840 BNE CHECK ;THEN CONTINUE SEARCHING.
78D5- A5 2C 1850 LDA #LIM
78D7- C5 2A 1860 CMP *PTR
78D9- D0 D9 1870 BNE CHECK
78DB- A2 81 1880 LDX #$81 ;IF NAME NOT FOUND, ABORT.

```

## APPLICATIONS

### Listing 3 (Continued)

```

78DD- 4C 59 C3 1890      JMP OUT
78EC- A0 02 1900 POINT   LDY #2 ;FOR THE MATCHING VARIABLE,
78E2- B1 2A 1910          LDA (PTR),Y ;GET LENGTH OF STRING
78E4- 85 5E 1920          STA *FACC ;AND STORE FOR LATER.
78E6- C8 1930          INY ; ;THEN GET POINTER TO STRING
78E7- B1 2A 1940          LDA (PTR),Y ;AND STORE IN THE NAME
78E9- 85 42 1950          STA *NAME ;AND STORE IN THE NAME
                                CELLS.

78EB- C8 1960          INY
78EC- B1 2A 1970          LDA (PTR),Y
78EE- 85 43 1980          STA *NAME+1
78F0- 68 1990          PLA ; ;RESTORE POINTER FOR
                                VARIABLE TABLE.

78F1- 85 2B 2000          STA *PTR+1
78F3- 68 2010          PLA
78F4- 85 2A 2020          STA *PTR
78F6- 60 2030          RTS
                                ;
2040          ;
2050          *****INDEX\SIZE .DE 215
2070          ;
2080 INDEX .BY '0'
2090          .SE SCALP#
78FA- CE 79 2100          .SI SCALP
2110          ;
2120          .BY '1'
78FD- C8 80 2130          .SE BROW#
78EF- 24 7A 2140          .SI BROW
2150          ;
2160          .BY '2'
7902- 90 81 2170          .SE MIDFACE#
7904- 89 7A 2180          .SI MIDFACE
2190          ;
2200          .BY '3'
7907- 58 82 2210          .SE CHEEKS#
7909- 07 7B 2220          .SI CHEEKS
2230          ;
2240          .BY '4'
790C- 20 83 2250          .SE NECK#
790E- 6D 7B 2260          .SI NECK
2270          ;
2280          .BY '5'
7911- 23 81 2290          .SE BROW#
7913- FF 7C 2300          .SI BROW\UP
2310          ;
2320          .BY '6'
7915- 23 81 2330          .SE BROW#
7918- 8F 7D 2340          .SI BROW\HIGH
2350          ;
2360          .BY '7'
791B- 23 81 2370          .SE BROW#
791D- 20 7D 2380          .SI BROW\SAD
2390          ;
2400          .BY '8'
7920- 23 81 2410          .SE BROW#
7922- 47 7D 2420          .SI BROW\PEAR
2430          ;
2440          .BY '9'
7925- 23 81 2450          .SE BROW#
7927- 6A 7D 2460          .SI BROW\DOWN
2470          ;
2480          .BY 'A'
792A- 74 81 2490          .SE EYES#
792C- C5 7B 2500          .SI EYES\AHEAD
2510          ;
2520          .BY 'B'
792F- 74 81 2530          .SE EYES#
7931- E0 7D 2540          .SI EYES\DOWN
2550          ;
2560          .BY 'C'
7933- 45 2570          .SE EYES#
7936- FB 7B 2580          .SI EYES\SAD
2590          ;
2600          .BY 'D'
7939- 74 81 2610          .SE EYES#
793B- 16 7C 2620          .SI EYES\BULGE
2630          ;
2640          .BY 'E'
793E- 74 81 2650          .SE EYES#
7940- 31 7C 2660          .SI EYES\LEFT
2670          ;
2680          .BY 'F'
7943- 74 81 2690          .SE EYES#
7945- 4C 7C 2700          .SI EYES\RIGHT
2710          ;
2720          .BY 'G'
7948- 74 81 2730          .SE EYES#
794A- 67 7C 2740          .SI L\EYE\CLOS
2750          ;
2760          .BY 'H'
794C- 4B 2770          .SE EYES#
794D- 7E 81 2780          .SI R\EYE\CLOSED
2790          ;
2800          .BY 'I'
7952- 74 81 2810          .SE EYES#
7954- 7D 7C 2820          .SI L\EYE\SQEZ
2830          ;

```

### Listing 3 (Continued)

```

7956- 4C 2840          .BY 'L'
7957- 7E 81 2850          .SE R\EYE#
7959- 88 7C 2860          .SI R\EYE\SQEZ
                                ;
2870          2880          .BY 'U'
795C- 74 81 2890          .SE EYES#
795E- 93 7C 2900          .SI EYE\HOOD
2910          ;
2920          .BY 'Q'
7961- 74 81 2930          .SE EYES#
7963- AE 7C 2940          .SI EYE\HOOD\L
2950          ;
2965- 50 2960          .BY 'P'
7966- 74 81 2970          .SE EYES#
7968- C9 7C 2980          .SI EYE\HOOD\R
2990          ;
299A- 49 3000          .BY 'I'
799B- 74 81 3010          .SE EYES#
799D- B4 7C 3020          .SI EYE\HOOD\D
3030          ;
3040          .BY '7'
7970- 40 82 3050          .SE NOSE#
7972- A2 7F 3060          .SI NOSE\NRML
3070          ;
3074- 39 3080          .BY '9'
7975- 40 82 3090          .SE NOSE#
7977- B6 7F 3100          .SI NOSE\UP
3110          ;
3120          .BY 'Z'
797A- B7 82 3130          .SE MOUTH#
797C- AB 7D 3140          .SI GRIN
3150          ;
3160          .BY '?'
797F- B7 82 3170          .SE MOUTH#
7981- DF 7D 3180          .SI SMILE
3190          ;
3200          .BY 'X'
7984- E7 82 3210          .SE MOUTH#
7986- OD 7E 3220          .SI LIPS\FLAT
3230          ;
3240          .BY 'N'
7989- B7 82 3250          .SE MOUTH#
798B- 3B 7E 3260          .SI LIPS\OPEN
3270          ;
3280          .BY 'B'
798E- B7 82 3290          .SE MOUTH#
7990- 6D 7E 3300          .SI LIPS\DOWN
3310          ;
3320          .BY 'V'
7993- B7 82 3330          .SE MOUTH#
7995- 95 7E 3340          .SI LIPS\FEAR
3350          ;
3360          .BY 'M'
7998- B7 82 3370          .SE MOUTH#
799A- C9 7E 3380          .SI LIPS\SNARL
3390          ;
3400          .BY ','
799D- B7 82 3410          .SE MOUTH#
799F- 33 7F 3420          .SI LIPS\PRESS
3430          ;
3440          .BY 'C'
79A2- B7 82 3450          .SE MOUTH#
79A4- 01 7F 3460          .SI LIPS\DSGST
3470          ;
3480          .BY '5'
79A7- 54 83 3490          .SE CHIN#
79A9- 61 7F 3500          .SI CHIN\UP
3510          ;
3520          .BY '6'
79AC- 54 83 3530          .SE CHIN#
79AE- 82 7F 3540          .SI CHIN\DOWN
3550          ;
3560          .BY '!'
79B1- 00 00 3570          .SE O
79B3- CA 7F 3580          .SI HAPPY
3590          ;
3600          .BY ')'
79B6- 00 00 3610          .SE O
79B8- D1 7F 3620          .SI SAD
3630          ;
3640          .BY '['
79B8- 00 00 3650          .SE O
79BD- D6 7F 3660          .SI SCARED
3670          ;
3680          .BY 'J'
79C0- 00 00 3690          .SE O
79C2- DD 7F 3700          .SI MAD
3710          ;
3720          .BY '<'
79C4- 3C 3720          .SE O
79C5- 00 00 3730          .SI DISGUSTED
3740          ;
3750          ;
3760          .BY '>'
79C8- 00 00 3770          .SE O
79CC- EB 7F 3780          .SI SURPRISED

```

## APPLICATIONS

### Listing 4

79CE 02 A0 06 74 02 20 08 64  
 79D6 6F 62 F8 E3 F8 62 6F 64  
 79DE 02 20 08 6A 02 A0 0D 02  
 79E6 20 07 6C FE 02 A0 09 62  
 79EE 7B 02 20 07 02 A0 0C EA  
 79F6 02 20 07 02 A0 0D 02 20  
 79FE 07 F4 02 A0 0B 61 02 20  
 7A06 06 E9 02 A0 0D DF 02 20  
 7A0E 06 E1 02 A0 0B 75 02 20  
 7A16 05 6C 02 A0 0F 7B 02 20  
 7A1E 05 6A 02 A0 06 00 02 A0  
 7A26 05 02 20 06 02 A0 11 02  
 7A2E 20 06 02 A0 A0 F6 02 20  
 7A36 05 E9 02 A0 11 DF 02 20  
 7A3E 05 E1 02 A0 09 75 02 20  
 7A46 04 E9 A0 01 11 A0 DF 02  
 7A4E 20 04 76 02 A0 09 74 20  
 7A56 20 20 6C A0 A0 01 11 A0  
 7A5E A0 7B 20 20 20 6A 02 A0  
 7A66 09 02 20 04 FE 02 A0 04  
 7A6E D2 F9 C6 A0 A0 E5 A0 E7  
 7A76 A0 A0 C6 F9 D2 02 A0 04  
 7A7E FC 02 20 04 F5 02 A0 04  
 7A86 03 26 00 A0 A0 A0 E7 20  
 7A8E 6C 62 FE DD 02 A0 04 CD  
 7A96 79 FE FD A0 C2 A0 C2 A0  
 7A9E ED FC 79 CE 02 A0 04 DD  
 7AA6 FC 62 7B 20 76 02 A0 07  
 7AAE EA 20 E1 A0 9C D9 02 A0  
 7AB6 09 C8 A0 D4 02 A0 09 D4  
 7ABE CE A0 61 20 6A 02 A0 07  
 7AC6 EA 20 7C FB A0 A0 C7 02  
 7ACE A0 13 D9 A0 A0 EC 7E 20  
 7AD6 6A 02 A0 07 E7 20 20 20  
 7ADE E2 FB C8 02 A0 13 C7 EC  
 7AE6 E2 20 20 20 76 02 A0 08  
 7AEE 75 20 20 20 E1 E7 02 A0  
 7AF6 08 D5 A0 C9 02 A0 08 E5  
 7AFE 61 02 20 04 F4 02 A0 04  
 7B06 00 02 A0 04 61 20 20 20  
 7B0E 6A 02 A0 08 F2 C6 A0 C6  
 7B16 F2 02 A0 08 74 20 20 20  
 7B1E 6A 02 A0 09 75 02 20 04  
 7B26 F4 02 A0 08 C5 E3 C5 02  
 7B2E A0 08 EA 02 20 04 76 02  
 7B36 A0 09 02 20 05 E1 02 A0  
 7B3E 13 61 02 20 05 02 A0 08  
 7B46 EA 02 20 05 76 EE 02 A0  
 7B4E 11 F0 75 02 20 05 F4 02  
 7B56 A0 07 61 02 20 05 6A ED  
 7B5E EE 02 A0 0F 0F FD 74 02  
 7B66 20 05 E1 02 A0 04 00 A0  
 7B6E A0 A0 74 02 20 05 67 A0  
 7B76 9C 02 A0 0F CE A0 65 02  
 7B7E 20 05 6A 02 A0 07 02 20  
 7B86 06 67 02 A0 13 74 02 20  
 7B8E 06 02 A0 06 61 02 20 06  
 7B96 6A 02 A0 13 75 02 20 06  
 7B9E E1 02 A0 05 02 20 07 76  
 7BA6 02 A0 13 61 02 20 07 02  
 7BAE A0 04 EA 02 20 07 E1 C2  
 7BB6 A0 13 F6 02 20 07 76 02  
 7BBE A0 02 03 5A 03 35 00 A0  
 7BC6 D2 F9 C6 A0 01 05 A0 C6  
 7BCE F9 D2 A0 01 19 A0 CD 79  
 7BD6 FE FD 01 05 ED FC 79 CE  
 7BDE A0 00 A0 D2 C6 C6 A0 01  
 7B65 05 A0 C6 C6 D2 A0 01 19  
 7BEE A0 CD 20 FE FD C1 05 ED  
 7BF6 EC 20 CE A0 00 E4 D2 F9  
 7BFE C6 CB 01 05 CA C6 F9 D2  
 7C06 E4 01 19 A0 9C 79 FE FD  
 7C0E 01 05 ED FC 79 AF A0 00  
 7C16 A0 AF F9 9C A0 01 05 AG

### Listing 4 (Continued)

7C1E AF F9 9C A0 01 19 A0 9C  
 7C26 79 FE FD 01 05 ED FC 79  
 7C2E AF A0 00 A0 D2 F9 C6 A0  
 7C36 01 05 A0 F9 C6 D2 A0 01  
 7C3E 19 A0 CD 62 A0 FD 01 05  
 7C46 ED 62 A0 CE A0 00 A0 D2  
 7C4E C6 F9 A0 01 05 A0 C6 F9  
 7C56 D2 A0 01 19 A0 CD A0 62  
 7C5E FD 01 05 ED A0 62 CE A0  
 7C66 00 02 A0 05 01 23 A0 9C  
 7C6E C6 C6 FD 00 02 A0 05 01  
 7C76 23 ED C6 C6 AF A0 00 02  
 7C7E A0 05 01 23 A0 E3 C5 C4  
 7C86 FD 00 02 A0 05 01 23 ED  
 7C8E C4 C5 E3 A0 00 A0 E4 E4  
 7C96 E4 A0 01 05 A0 E4 E4 E4  
 7C9E A0 01 19 A0 CD 79 FE FD  
 7CA6 01 05 ED FC 79 CE A0 00  
 7CAE A0 E4 E4 E4 A0 01 05 A0  
 7CB6 E4 E4 A0 01 19 A0 CD  
 7CBE 62 A0 FD 01 05 ED 62 A0  
 7CC6 CE A0 00 A0 E4 E4 A0  
 7CCE 01 05 A0 E4 E4 E4 A0 01  
 7CD6 19 A0 CD A0 62 FD 01 05  
 7CDE ED A0 62 CE A0 00 A0 E4  
 7CE6 E4 E4 A0 01 05 A0 E4 E4  
 7CEE E4 A0 01 19 A0 CD 20 FB  
 7CF6 FD 01 05 ED EC 20 CE A0  
 7CFE 00 EF 77 63 E2 EF 02 A0  
 7D06 07 EF E2 63 77 EF 01 17  
 7D0E F7 A0 A0 F8 79 77 FB A0  
 7D16 A0 A0 EC 77 79 F8 A0 A0  
 7D1E F7 00 A0 E4 EF E4 A0 E4  
 7D26 EF A0 A0 EF A0 E4 A0 E4  
 7D2E EF E4 A0 01 17 62 F8 62  
 7D36 79 6F 79 F7 A0 A0 A0 F7  
 7D3E 79 6F 79 62 F8 62 03 45  
 7D46 00 F9 E2 78 E2 F9 E2 F9  
 7D4E A0 A0 A0 F9 E2 F9 E2 78  
 7D56 E2 F9 01 17 E3 A0 E3 F7  
 7D5E F8 F7 02 A0 05 F7 F8 F7  
 7D66 E3 A0 E3 00 EF 78 77 F9  
 7D6E EF E4 A0 DD DD A0 F4  
 7D76 EF F9 77 78 EF 01 17 F7  
 7D7E A0 E3 F8 79 6F 7C CB A0  
 7D86 CA 7E 6F 79 F8 E3 A0 F7  
 7D8E 00 A0 78 63 6F 64 63 FB  
 7D96 A0 A0 A0 EC 63 64 6F 63  
 7D9F 78 A0 01 17 F7 E3 C2 A0  
 7DA6 CD E3 FF A0 00 A0 A0 F4  
 7DAE EF E4 EF E4 A0 01 1F  
 7DB6 7B 6C 62 62 79 62 7B  
 7DBE 6C 01 1F A0 7B 63 77 77  
 7DC6 77 63 6C A0 01 1F A0 A0  
 7DCE F7 F8 F7 F8 F7 A0 A0 01  
 7DD6 1E 02 A0 0B 03 35 03 37  
 7DDE 00 A0 A0 E4 EF E4 EF E4  
 7DE6 A0 A0 01 1F 7B 43 46 46  
 7DEE 52 46 46 H3 6C 01 1F A0  
 7DF6 F7 79 6F 79 6F 79 F7 A0  
 7DFF 01 1F 02 A0 09 01 1E 02  
 7E06 A0 0B 03 35 03 37 00 02  
 7E0E A0 09 01 1F EC 78 77 63  
 7E16 77 63 77 78 FB 01 1F A0  
 7E1E 62 63 63 45 63 63 62 A0  
 7E26 01 1F A0 A0 A0 F7 E3 F7  
 7E2E A0 A0 01 1E 02 A0 0B  
 7E36 03 35 03 37 00 02 A0 09  
 7E3E 01 1F A0 69 63 20 63 20  
 7E46 63 5F A0 01 1F A0 20 7C  
 7E4E E2 E2 7E 20 A0 01 1F  
 7E56 A0 FC 02 20 05 FE A0 01  
 7E5E 1F 02 A0 04 F8 62 F8 02  
 7E66 A0 04 03 36 03 37 00 02

### Listing 4 (Continued)

7E66 A0 09 01 1F EC 77 63 46  
 7E76 63 46 63 77 FB 01 1F F7  
 7E7E E3 F8 62 F8 62 F8 E3 F7  
 7E86 01 1F 02 A0 09 01 1E 02  
 7E8E A0 0B 03 35 03 37 00 A0  
 7E96 A0 E4 EF E4 EF E4 A0 A0  
 7E9E 01 1F 69 6C 62 62 79 62  
 7EA6 62 7B 5F 01 1F DF 63 77  
 7EA8 78 77 77 63 63 E9 01 1F  
 7EB6 A0 A0 F7 F8 F7 F8 F7 A0  
 7EBE A0 01 1E 02 A0 0B 03 35  
 7EC6 03 37 00 A0 A0 EF F9 EF  
 7ECE F9 EF A0 A0 01 1F A0 69  
 7ED6 6C F8 F8 7B 5F A0 01  
 7EDE 1F E7 02 20 07 E5 01 1F  
 7EE6 A0 DF 77 F9 EF F9 77 E9  
 7EEE A0 01 1E 02 A0 03 F7 F8  
 7EF6 62 F8 F7 02 A0 03 03 36  
 7FEF 03 37 00 A0 EC 77 77 78  
 7F06 77 77 FB A0 01 1F A0 6C  
 7FOE 02 A0 05 7B A0 01 1F A0  
 7F16 79 20 63 63 63 20 79 A0  
 7F1E 01 1F A0 A0 A0 E3 A0 E3  
 7F26 A0 A0 A0 01 1E 02 A0 0B  
 7F2E 03 35 03 39 00 A0 EF F9  
 7F36 E2 F9 E2 F9 EF A0 01 1F  
 7F3E C5 F8 62 79 62 79 62 F8  
 7F46 C5 01 1F CA A0 A0 A0 F2  
 7F4E A0 A0 AC CB 01 1F 02 A0  
 7F56 09 01 1E 02 A0 0B C3 35  
 7F5E 03 39 00 ED EE 01 0B F0  
 7F66 FD 01 1A A0 C4 EE 01 07  
 7F6E F0 C4 A0 01 1D A0 C3 D2  
 7F76 CO D2 CO D2 C3 A0 01 20  
 7F7E 02 A0 07 00 CD A0 01 0B  
 7F86 A0 CE 01 1A CA C9 02 A0  
 7F8E 09 D5 CB 01 1D 9C 02 A0  
 7F96 07 AF 01 20 E3 C4 E3 C4  
 7F9E E3 C4 E3 00 A0 A0 D5 A0  
 7FA6 C9 A0 A0 01 22 F2 C6 A0  
 7FAE C6 F2 01 24 C5 E3 C5 00  
 7FB6 CE A0 D5 A0 C9 A0 CD 01  
 7FBE 22 ED D2 A0 D2 FD 01 24  
 7FC6 A0 E3 A0 00 03 26 03 54  
 7FCE 03 5A 00 03 25 03 42 00  
 7FD6 03 23 03 59 03 56 00 03  
 7FDE 24 03 55 03 2C 00 03 26  
 7FE6 03 55 03 43 00 03 5C 03  
 7FEE 59 03 4E 00 12 20 12 20

### Additional Readings

Paul Ekman and Wallace V. Friesen, *Unmasking the Face* (Prentice-Hall, 1975), and Carroll E. Izard, *The Face of Emotion* (Appleton-Century-Crofts, 1971).

David Heise is Professor of Sociology at Indiana University. He recently edited "Microcomputers in Social Research" (Sage Publications, 1981). His books include *Causal Analysis* and *Understanding Events*. He plans to use the face program in a longer program for simulating social interaction. He may be contacted at the Department of Sociology, Indiana University, Bloomington, IN 47405.

MICRO

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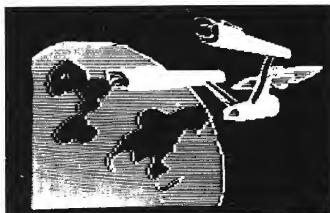
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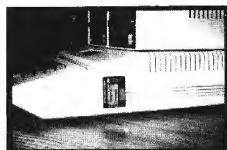


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# A Low-Cost Digitizer for the Apple

by Jay Sinnott

**If you have a computer with high-resolution graphics, then you already own 99% of a digitizer with equal resolution. This article tells you how to use a sheet of half-reflecting plastic to build the rest. The modular demonstration program should be easy to customize to your application. The article also describes a "crashproof" disk access which should be of interest to those who have puzzled over details of the Applesoft ONERR GOTO command.**

**Digitizer Demo**  
requires:

Apple II or Apple II Plus with 48K  
One disk drive  
Applesoft BASIC

Although **Digitizer Demo** is implemented on the Apple II, the method described here can be implemented on any microcomputer offering high-resolution graphics

A digitizer is a device used to translate pictures into sets of X and Y coordinates for use in a computer. Digitizers are used in research for measuring the size, shape, or position of objects that have been photographed or videotaped, reading strip chart recordings, etc. Hobbyists might use digitizers to copy shapes into the computer's memory from drawings made with pencil and paper. Unfortunately, most digitizers available for use with popular microcomputers cost several hundred dollars. In this article, I will describe one that can be built for under \$20.00 and can be used with any microcomputer having high-resolution graphics. A sample program written for the Apple II<sup>1</sup> demonstrates the simplicity of the software required to implement the digitizer.

Most inexpensive digitizers work this way: the operator moves a mechanical pointer around on a photo or drawing while its X and Y coordinates are measured electrically and sent to the computer. Usually the pointer has to be in physical contact with the picture so that the operator's perspective won't cause parallax errors. In this digitizer the pointer is actually a cursor on the Apple's high-resolution screen. This is optically superimposed onto the photo, drawing, or flat object to be digitized using a half-silvered ("two-way") mirror. When this is done correctly, there is no parallax error because both images are optically in the same place.

To build the digitizer, I first placed two identical monitors facing each other, about 10" apart, with a sheet of window-plastic exactly halfway between them and parallel to the monitor screens, as shown in figure 1. This worked, but plastic alone reflected weakly, and there was an image from both near and far sides, which was distracting. Then I obtained some half-silvered two-way mirror plastic film and applied it to the near side of the window: success! Both direct and reflected images were equally strong, and only one reflection was visible.

The reflecting plastic I used was secondhand and did not form a perfectly smooth surface. Because the uneveness

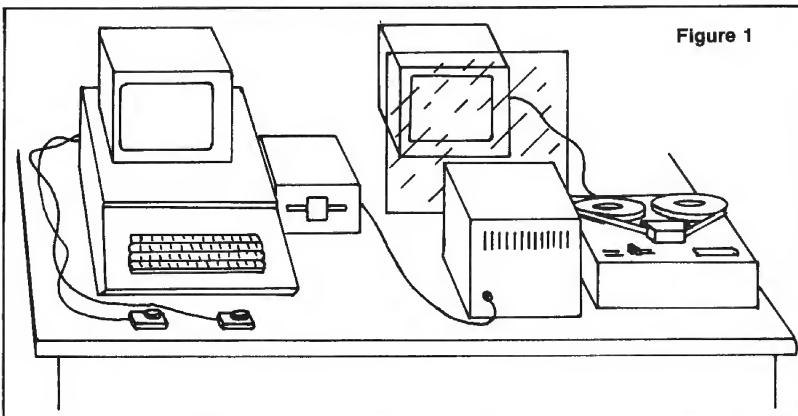


Figure 1

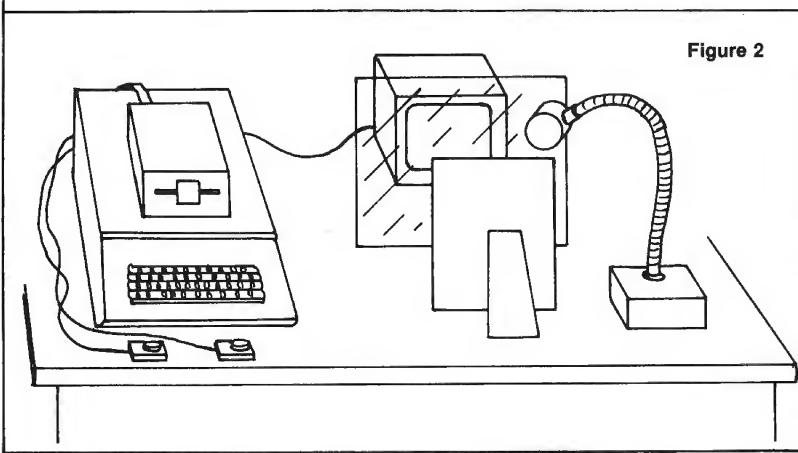


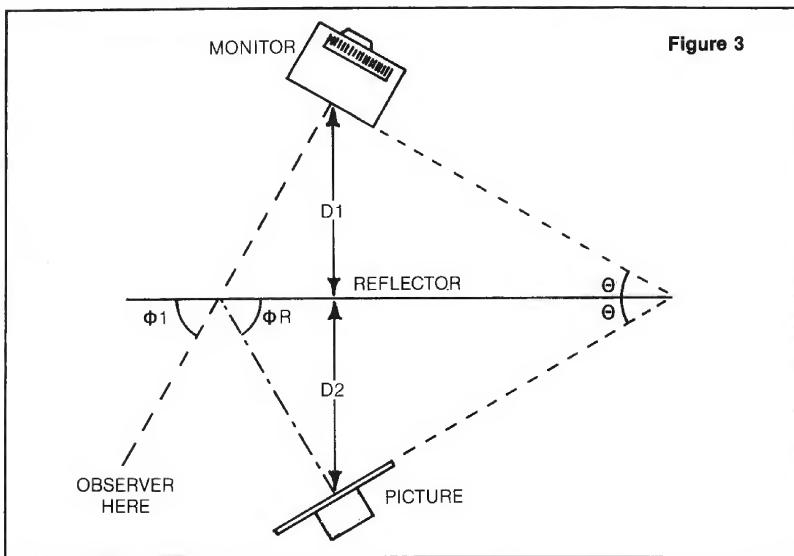
Figure 2

caused by tiny bubbles in the plastic distorted the reflected image, I found it best to look through the mirror at the video image, while using the reflected image of the Apple monitor. (A slight distortion of the cursor on the reflected Apple monitor seemed to be less distracting than distortion of the picture being digitized.) This arrangement also let me see the picture without a left-right reversal caused by mirror reflection. A third monitor was used for normal Apple monitor functions, so that the one being used for digitizing could be left in place once it was aligned.

If you want to digitize photos, drawings, etc., and you don't have extra monitors, I recommend you follow the layout of figure 2. In this setup you can read your Apple monitor normally through the glass. New one-way plastic carefully applied to a clean pane of window glass should give you acceptably clear reflections of the picture you are working on; if not, you can get a glass one-way mirror. The one-way plastic is sold in nationwide automotive parts and customizing shops; a 20-inch by 10-foot roll costs \$10 - \$15. One-way glass is more expensive; an 18-inch by 18-inch pane will set you back \$20 - \$30. A reading lamp may be needed to balance the intensities of the two images.

Before you can begin digitizing, the images must be aligned correctly, and the best tools are your eyes. First, set up the equipment as shown in figure 2. Be careful to have the mirror, monitor, and picture vertical, not leaning either way. Run the DIGITIZER DEMO program and use the paddles to align the cursor from the Apple monitor directly over the reflection of some spot on the picture. A small dot that just fits within the cursor works well. Now lean your head close to the mirror. With the aid of binocular (both eyes) depth perception, you should be able to see whether the cursor or the spot appears to be closer to you. Move either the picture or the monitor until the reflected image appears to be exactly the same distance from you as the non-reflected one. (This is easier than it sounds!) Check two or three points to be sure the angles are right.

With precise alignment, the image of a stationary cursor won't move with respect to the picture even when you move your head. In fact two people can look at the setup at once and see the same thing! The principle behind this position-independent superimposition is the optical law that states: "the angle of incidence is equal to the angle of reflection." This law will work even



if the monitor screen and the picture are not parallel to the glass. Just be sure that the reflection lines up exactly with the direct image. In figure 3, as long as  $D_1 = D_2$  and  $\Theta$  is the same on both sides, the eye can be moved freely and the images will remain superimposed.

Obviously, the size of the picture you can digitize is limited by the size of your monitor screen, and the resolution is set by the Apple's 280 by 192 high-resolution grid. Most television monitors introduce some distortion to both horizontal and vertical axes, squeezing the picture in some places and stretching it in others. To remedy this, calibrate your own particular monitor by digitizing many points from an accurate target grid (such as graph paper). Then calculate correction factors to map the monitor's coordinates into an accurate array.

The digitizer demonstration program presented in listing 1 was designed to allow easy modification or expansion. It is written in structured format with several small blocks of code, each performing only one well-defined function, much like procedures in Pascal.

Lines  
 1000-1240 Initialize variables.  
 1700-1850 Load a binary file which defines cursor shapes.  
 2000-2050 Read paddle values. Scale to be within the range 0-1.  
 3000-3070 Translate paddle values to X and Y coordinates for display. Use offset and scale factors.

4000-4080	Draw cursor on screen at selected location. Remember location.
4500-4550	Erase cursor from remembered screen location.
5000-5050	Print current cursor location on screen in text window.
6000-6090	Read and debounce buttons.
7000-7560	Toggle from coarse to fine motion control and back again.
8000-8050	Pseudo output routine... print cursor location on screen in text windows.
9000-9050	Check keyboard for any activity.
20000-20160	Main routine.

Lines 1060, 1070, and 1180 extract the address of a BLOADED shapefile from the DOS file pointer<sup>2</sup> (of a 48K Apple) and copy it into the Applesoft shapefile pointer. (This technique can be helpful in shape-generating programs, too.)

Lines 1700-1850 are a crashproof version of a BLOAD command that returns an error flag, ER, if the specified file is not on disk. If there is any kind of error in reading file SF\$ from the disk in line 1780, control will immediately be passed to line 1800. This is the function of the Applesoft ONERR GOTO 1800 command in line 1770. The Applesoft manual<sup>3</sup> warns you that ONERR GOTO has a bug and gives you a machine-language patch to fix it. This is exercised by the CALL 768 in line

## APPLICATIONS

1840 [which assumes that the patch has been placed into memory as instructed in the manual]. When the Apple returns from this call, the return address for the most recent unfinished GOSUB has been discarded. I use a dummy GOSUB in line 1730, so it can be thrown away if there is an error. A normal BLOAD will result in line 1790 RETURNING to line 1740 but the error routine ends with a GOTO 1740 instead of a RETURN. Both the normal and the error exits from the BLOAD routine execute lines 1740 and 1750.

Control of cursor motion can be accomplished in at least two ways. I have used the paddles for cursor motion [lines 1000-3070], but I have seen perfectly good cursor motion controls implemented on a PET with just the standard keyboard. In this program I provide both coarse and fine motion control for two reasons. First, the 256 possible values for the X-axis paddle [0] cannot be translated into 280 values for the screens X-axis without leaving out some points, whereas only 192 of the possible 256 Y-axis paddle [1] values are used. Second, it is easier to make fine position adjustments when the paddles are less sensitive and operate over a small section of the screen.

The mode is controlled by the button on paddle 0, which makes the program toggle back and forth between coarse and fine resolution every time it is pressed. The apparent center of the fine-tuning square is placed exactly where the coarse cursor was when the button was pressed, and different cursors are used for each mode so that the operator knows which mode he is using. The button on paddle 1 triggers an output subroutine that could send a value to disk or tape (but is displayed on the screen in this demonstration).

There are no IF statements in the routines that draw and erase the cursor, and the only IF statements in the paddle-to-screen translation are for range checking. The coarse/fine switching is all accomplished by resetting variables for screen origin (XO,YO), scale factor (XM,YM), paddle shift (FT), and cursor shape (CU) [lines 7000-7560]. I have found this technique of modifying variables to set flags and to pass parameters is much easier to write and debug than a maze of IF statements. It forces you to plan your program before you start writing, but the effort is repaid many times over.

Whenever I plan to use high-resolution graphics, I first reset the Apple's memory pointers to protect the

### Listing 1

```

10 GOTO 20000: REM MAIN PROGRAM (STRUCTURED PROGRAM HAS SUBROUTINES FIRS
T)
20 REM ****
30 REM
40 REM DIGITIZER DEMO REV 1
50 REM
60 REM BY JAY C. SINNETT
70 REM JULY 8, 1981
80 REM U.S. EPA ENVIRONMENTAL RESEARCH LABORATORY
90 REM SOUTH FERRY ROAD
100 REM NARRAGANSETT, RI 02882
110 REM
120 REM ****
1000 REM
1010 REM INITIALIZATION ROUTINE
1020 REM
1030 TEXT : HOME
1040 CD$ = CHR$ (4): REM CONTROL-D
1050 KA = 49152: REM KEYBOARD ADDRESS
1060 BA = 43634: REM ADDRESS OF DOS POINTER TO BLOADED FILE (48K APPLE)
1070 PL = 232: REM POINTER TO SHAPE TABLE USED BY APPLESOFT
1080 SO = 49249:SI = 49250: REM ADDRESSES FOR GAME CONTROL BUTTONS
1090 XO = 0:YO = 0: REM OFFSET (FLOATING ORIGIN)
1100 XH = 279:YM = 191: REM HIGHEST VALUES FOR SCREEN X,Y
1110 XF = 64:YF = 64: REM SCALE FACTOR FOR FINE MOTION
1120 XM = XH:YM = YM: REM MULTIPLIER (EITHER FULL SCREEN OR FINE MOTION)
1130 PRINT "WHAT IS THE NAME OF YOUR CURSOR SHAPE TABLE ";
1140 INPUT " ";F1$;F2$= "BUGCURSOR": IF LEN (F1$) < > 0 THEN SFS = F1$:FI = 1
1150 FI = 0:SFS = "BUGCURSOR": IF LEN (F1$) < > 0 THEN SFS = F1$:FI = 1

1160 GOSUB 1700: REM SAFE BLOAD
1170 IF ER THEN PRINT "SORRY, CAN'T FIND "SFS: PRINT CD$"CATALOG": GOTO
1180 130
1180 POKE PL, PEEK (BA): POKE PL + 1, PEEK (BA + 1): REM SET SHAPETABLE
1190 POKE CU, PEEK (BA + 2): REM SET COARSE C
1190 CC = 2:CF = 3: IF NOT FI THEN 1220: REM DEFAULT IS BUGCURSOR SET
1200 INPUT "WHICH CURSOR NUMBER DO YOU WANT TO USE FOR COARSE POSITION?
";CC
1210 INPUT "WHICH CURSOR DO YOU WANT FOR FINE POSITIONING? ";CF
1220 CU = CC: REM START WITH COARSE CURSOR
1230 HOME : SCALE= 1: ROT= 0: HGR
1240 RETURN
1700 REM
1710 REM BLOAD SFS
1720 REM
1730 GOSUB 1760: REM DUMMY CALL FOR ERROR TRAP TO WORK
1740 POKE 216,0: REM TURN OFF ERROR PROCESSING
1750 RETURN : REM TO MAIN CALLING ROUTINE
1760 ER = 0: REM ERROR FLAG RETURNED TO CALLING ROUTINE
1770 ONERR GOTO 1800
1780 PRINT CD$"BLOAD"SFS
1790 RETURN : REM SUCCESSFUL
1800 REM
1810 REM ERROR TRYING TO LOAD FILE
1820 REM
1830 ER = PEEK (222): REM ERROR CODE, IF YOU WANT
1840 CALL 768: REM STRAIGHTEN OUT SUBROUTINE STACK, REMOVING ONE RETURN
1850 ADDRESS
1850 GOTO 1740
2000 REM
2010 REM READ PADDLES, SCALE 0 TO 1
2020 REM
2030 XP = PDL (0) / 255
2040 FOR N = 1 TO 10: NEXT : REM DELAY FOR PDL CIRCUIT
2050 YP = PDL (1) / 255
3000 REM
3010 REM TRANSLATE PDL VALUES
3020 REM
3030 X = XO + INT ((XP - FT) * XM): IF X < 0 THEN X = 0
3040 IF X > XH THEN X = XH
3050 Y = YO + INT ((YP - FT) * YM): IF Y < 0 THEN Y = 0
3060 IF Y > YM THEN Y = YM
3070 RETURN
4000 REM
4010 REM PLACE CURSOR ON SCREEN
4020 REM
4030 XS = XH - X: REM REVERSE LEFT/RIGHT
4040 YS = YM - Y: REM ORIGIN AT BOTTOM OF SCREEN
4050 HCOLOR= 3
4060 DRAW CU AT XS,YS
4070 X1 = X:Y1 = Y: REM REMEMBER COORDINATES USED LAST
4080 RETURN
4500 REM
4510 REM ERASE CURSOR FROM SCREEN
4520 REM
4530 HCOLOR= 0
4540 DRAW CU AT (XH - X1),(YM - Y1)
4550 RETURN
5000 REM
5010 REM DISPLAY CURRENT CURSOR LOCATION

```

(Continued)

## APPLICATIONS

### Listing 1 (Continued)

```

5020 REM
5030 VTAB 22: PRINT "          ": REM ERASE LAST
      DATA
5040 VTAB 22: PRINT "X = "X" Y = "Y
5050 RETURN
5000 REM
5010 REM      READ BUTTONS (DEBOUNCING)
5020 REM
5030 FO = 0:F1 = 0
5040 SA = PEEK (S0) > 127: REM 1 IF BUTTON 0 DOWN
5050 SR = PEEK (S1) > 127: REM BUTTON 1
5060 IF SA AND NOT SR THEN FO = 1: REM FO IS FLAG FOR BUTTON 0 BEING PRESSED
5070 IF SB AND NOT SR THEN F1 = 1: REM FLAG FOR BUTTON 1
5080 SQ = SA:SR = SB: REM REMEMBER PREVIOUS STATE
5090 RETURN
7000 REM
7010 REM      TOGGLE SCALE FACTOR, ORIGIN
7020 REM
7030 IF XM = XH THEN 7500
7040 REM ELSE HERE TO CHANGE FROM FINE TO COARSE
7050 XO = 0:YO = 0: REM ORIGIN
7060 XM = XH:YM = YH: REM SCALE FACTOR
7070 CU = CC: REM CURSOR TYPE
7080 FT = 0: REM NO SHIFT OF PADDLE
7090 GOTO 7560 REM END ELSE
7500 REM HERE TO CHANGE FROM COARSE TO FINE MOTION
7510 XO = X
7520 YO = Y
7530 XM = XF:YM = YF: REM SCALE
7540 CU = CP: REM CURSOR
7550 FT = .5: REM SHIFT PADDLES TO CENTERED PLUS/MINUS RANGE
7560 RETURN
8000 REM
8010 REM      OUTPUT ROUTINE...TO SCREEN FOR THIS DEMO
8020 REM
8030 VTAB 23: PRINT "          ": REM ERASE
      OLD POINT
8040 VTAB 23: PRINT "LAST 'PLOTTED' POINT: X = "X" Y = "Y
8050 RETURN
9000 REM
9010 REM      CHECK KEYBOARD
9020 REM
9030 KF = PEEK (KA) > 127: REM TRUE IF A KEY HAS BEEN PRESSED
9040 IF KF THEN GET KBS: REM RETURN WITH IDENTITY OF KEY IN KBS
9050 RETURN
20000 REM
20010 REM      MAIN ROUTINE
20020 REM
20030 GOSUB 1000: REM INITIALIZE
20040 GOSUB 2000: REM GET DESIRED COORDINATES
20050 IF X1 = X AND Y1 = Y THEN GOTO 20110
20060 REM IF COORDINATES HAVE CHANGED, ERASE OLD CURSOR AND PLACE NEW ON E
20070 GOSUB 4500: REM ERASE OLD CURSOR
20080 GOSUB 4000: REM PLACE NEW CURSOR
20090 GOSUB 5000: REM DISPLAY CURRENT LOCATION
20100 REM END IF
20110 GOSUB 6000: REM READ BUTTONS INTO FO, F1
20120 IF FO THEN GOSUB 4500: GOSUB 7000: GOSUB 4000: REM TOGGLE SCALE FACTOR
20130 IF F1 THEN GOSUB 8000: REM 'OUTPUT' A DATA POINT
20140 GOSUB 9000: REM CHECK KEYBOARD
20150 IF KF THEN END : REM FOR THIS DEMO
20160 GOTO 20040

```

### Listing 2

800.882

```

0800- 03 00 08 00 1F 00 50 00
0808- 24 24 24 B4 92 D2 3F 3F
0810- 3F 4D 49 09 2D 2D 2D DF
0818- DB 13 36 36 16 24 00 DB
0820- 3F 3F 24 64 0D 18 0C 0D
0828- 18 2D 35 36 26 08 18 08
0830- 2D 0E 0E 0E 0E 36 FE 1B
0838- 2D AD 36 1E 1E 1E 1E 3F
0840- 27 24 B4 D2 3F 0F 18 0F
0848- 18 0F 18 0F 18 24 04 00
0850- 1B 3F 3F 6F 20 64 0D 18
0858- 2D 25 30 16 36 0C 18 08
0860- 2D 0E 0E 36 FE 2B 6D FD
0868- 8B 36 CE F3 1E 38 0F 18
0870- 08 18 36 36 26 C8 3B 0F
0878- 18 0F 18 0F 98 51 E2 1C
0880- 24 04 00
*
```

entire space from \$800 to the top of page one high-resolution graphics at \$4000. This leaves about 20K of contiguous program space and 6K of shapefile space available. The following series of POKEs should be used to accomplish this:

```

POKE 103,1
POKE 104,64
POKE 16384,0

```

The shape table used by this program is shown in monitor format (listing 2), occupying locations \$800-\$882. It actually has three cursors available: a crosshair and two different circle/crosshair combinations. The DIGITIZER DEMO program assumes that it is stored on disk under the name BUGCURSOR. If you use it as shown, you *must* reset the memory pointers before running DIGITIZER DEMO, or the program will be destroyed when the shapefile is loaded.

The hardware and software I have described here were originally developed for a government research project, but they should be useful for a great many other applications. Your output routine might simply connect points as you enter them, making a line drawing, or you might want to save points in a shapefile or in a disk data file. All sorts of graphics programming should be easier and more fun with this affordable digitizer.

### References

1. Mention of commercial products does not imply endorsement by the U.S. Environmental Protection Agency.
2. *The DOS Manual*, Apple Computer, Inc., Cupertino, CA 95014, 1980. Page 144 (DOS Entry Points).
3. *Basic Programming Reference Manual*, Apple Computer, Inc., Cupertino, CA 95014, 1978. Page 136 (Machine-Language program to clear up ONERR GOTO problem).

Jay Sinnett has a B.S. degree in electronics from MIT (1968). After three years in the Navy, he joined the Environmental Protection Agency and has been at his present position for seven years. He programs extensively in machine language and Microsoft BASIC on the SYM, PET, and Apple II at work. He may be contacted at the United States Environmental Protection Agency, Environmental Research Laboratory, South Ferry Road, Narragansett, RI 02882.

MICRO

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(Anix, Pascal, Sources)	<b>\$99.95</b>
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DATA/DOC	\$42.95/ <b>\$39.95</b>	Typing Tutor	\$24.95/ <b>\$19.95</b>
List Master	\$39.95/ <b>\$29.95</b>	Fortran	\$195.00/ <b>\$135.95</b>
30% OFF		AL.D.S.	\$125.00/ <b>\$89.95</b>
ASCII Express	\$79.95/ <b>\$59.95</b>	Basic Compiler	\$39.95/ <b>\$29.95</b>
Z-Term (reqs 2-80 Card)		Coco	\$75.00/ <b>\$49.00</b>
Z-Term Pro		TASC	\$175.00/ <b>\$129.95</b>
Easy Writer 40-column	\$49.95/ <b>\$39.95</b>	Data Plot	\$59.95/ <b>\$44.95</b>
Easy Writer 40-column	\$69.95/ <b>\$49.95</b>	DB Utility Pack	\$99.00/ <b>\$69.95</b>
Easy Writer 40-column	\$99.95/ <b>\$74.95</b>		
Easy Writer 40-column	\$175.00/ <b>\$124.95</b>		
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# AIM Logic Trainer

by Larry Kollar

**Test your logic circuits with this program. It allows you to control the inputs and send the outputs to LEDs or printer.**

**Logic Trainer**  
requires:

AIM 65  
and your logic circuit  
Information is provided to aid  
conversion for other 6502  
computers

In the course of a hardware project, sooner or later you need to test it. If your breadboard comes with a power supply, debounced switches, and lights, it's simple enough.

However, most of us have to debounce switches and put limiting resistors in series with our LEDs. If your project uses several IC packages, you may not have room to add the necessary circuitry.

Listing 1 is the assembly language program of my computerized circuit tester. Just attach some wires to a 44-pin connector (see table 4 for connections), plug the connector onto J1 and attach the circuit. (Do this with the AIM turned off.) Turn on the computer, load the program, and start it at \$0200. The display shows eight switches (all initially OFF) as '1' = ON, '0' = OFF. Eight outputs (lights) are represented by '\*' = ACTIVE, '-' = INACTIVE. (See listing 2.)

Now you can toggle any switch by hitting '1' through '8' on the AIM keyboard. '1' toggles the leftmost switch, '8' toggles the one on the far right. Hitting any switch twice in a row will return it to its original state. The following procedure enables you to add features that you probably couldn't find on any hardware laboratory trainer.

**Table 1: Logic Trainer Commands**

Command	Function
'1'..'8'	Toggle switches 1 through 8.
{space}	Single-step.
'A'	Auto-step.

**Table 2: Delay Routine**

Address	Initial Value	Effects of Change
\$02B9	\$00	To \$80 will cut the delay by half (approximately 3/8 second), larger values will cut it more.
\$02BB	\$71	For these locations, increasing the values will lengthen the delay.
\$02C0	0B	\$02BB is a "fine tune" value; \$02C0 is more critical.

**Table 3: I/O Routines and VIA**

Name	Function
CRLF	Output Carriage Return and Line Feed to the Display/Printer.
DE1	Delay subroutine.
OUTPUT	Send the ASCII character in the accumulator to the Display/Printer.
READ	Get an ASCII character from the keyboard to the accumulator.
ORB	VIA Port B (lights).
ORA	VIA Port A (switches).
DDR8	VIA Port B data direction register.
DDRA	VIA Port A data direction register.
ACR	VIA Auxiliary Control Register.
PCR	VIA Peripheral Control Register.

# APPLICATIONS

**Listing 1**

```

;* LOGIC TRAINER PROGRAM
;* BY LARRY KOLLAR
;*
;EXTERNAL REFERENCES:
;READ EQU $E93C
;OUTPUT EQU $E97A
;CRLF EQU $E9FO
;TIMER EQU $EC18
;PORTB EQU $A000
;PORTA EQU $A001
;DDR B EQU $A002
;DDRA EQU $A003
;T2L EQU $A008
;T2H EQU $A009
;ACR EQU $A00B
;PCR EQU $A00C
;PRIFLG EQU $A411
;ORG $200
;OBJ $800
;
;INITIALIZE AND GET INSTRUCTION
;
0200 20 3B 02 JSR INIT      ;INITIALIZE VIA
0203 20 4C 02 RSTRT JSR RESET ;INITIALIZE SWITCHES
0206 20 52 02 START JSR STATE ;DISPLAY LOGIC STATES
0209 20 3C E9 GTCMD JSR READ ;AND GET A COMMAND
020C C9 20 CMP #$20 ;SPACE? (FOR 1-STEP)
020E FO 25 BEQ STEP1 ;ELSE 'A'? (AUTOSTEP)
0210 C9 41 CMP 'A' ;ELSE 'A'? (AUTOSTEP)
0212 FO 74 BEQ AUTO
0214 ;
0214 ;TOGGLE SWITCHES 1-8:
0214 ;
0214 38 TOGGL SEC      ;OR TEST FOR TOGGLE
0215 E9 30 SEC #$30 ;ASCII CHAR TO VALUE
0217 30 FO BMI GTCMD ;<17 THEN TRY AGAIN
0219 C9 09 CMP #$09
021B 10 EC BPL GTCMD ;ALSO, IF >9 TRY AGAIN
021D 85 00 STA $00 ;NOW TURN IT AROUND
021F A9 09 LDA #$09 ;SO THAT '1' REFERS
0221 38 SEC ;TO THE LEFTEST ONE
0222 E5 00 SRC $00 ;USE THIS FOR COUNTER
0224 AA TAX
0225 A9 00 LDA #$00 ;PUT A BIT IN
0227 38 OUT1 ROL A ;AND FIND OUT WHERE
0229 CA DEX ;IT GOES
022A D0 FC ENE OUT1 ;TOGGLE THAT BIT
022C 4D 01 A0 BOR PORTA ;AND PUT IT IN
022F 8D 01 A0 STA PORTA ;AND GO BACK FOR MORE
0232 4C 06 02 JMP START
0235 ;
0235 ;SINGLE-STEP SWITCHES
0235 ;
0235 EE 01 A0 STEP1 INC PORTA
0238 4C 06 02 JMP START
023B ;
023B ;INITIALIZE VIA
023B ;
023B A9 FF INIT LDA #$FF ;PORT A=SWITCHES
023D 8D 03 A0 STA DDRA ;PORT B=LIGHTS
0240 A9 00 LDA #$00 ;JUST MAKE SURE THESE
0242 8D 02 A0 STA DDRB ;DON'T DO ANYTHING
0245 8D 08 A0 STA ACR ;AND GO BACK
0248 8D 0C A0 STA PCR
024B 60 RTS
024C ;
024C ;RESET ALL SWITCHES
024C ;
024C A9 00 RESET LDA #$00 ;CLEAR DISPLAY
024E 8D 01 A0 STA PORTA ;GET THE SWITCHES
0251 60 RTS ;LOOP FOR SWITCHES
0252 ;
0252 ;UPDATE SWITCH/LIGHTS
0252 ;
0252 20 FO E9 STATE JSR CRLF ;MOVE IT INTO CARRY
0255 AD 01 A0 LDA PORTA ;SAVE A
0258 A2 08 LDX #$08 ;ASSUME SWITCH=OFF
025A 2A SWOUT ROL A ;IF CARRY, WE'RE WRONG
025B 48 RHA ;SO LOAD WITH '1'
025C A9 30 LDA '0' ;AND PRINT THAT
025E 90 02 BCC *+4 ;GET A BACK
0260 A9 31 LDA '1' ;AND KEEP GOING
0262 20 7A E9 JSR OUTPUT ;UNTIL ALL 8 ARE OUT
0265 68 PLA ;PUT IN 4 SPACES
0266 CA DEX ;BETWEEN SWITCHES AND
0267 D0 F1 ENE SWOUT ;THE LIGHTS
0269 A2 04 LDX #$04
0268 A9 20 LDA #$20
026D 20 7A E9 SPACE JSR OUTPUT
0270 CA DEX
0271 D0 FA ENE SPACE

```

**Listing 1 (Continued)**

```

0273 AD 00 A0 LDA PORTB ;NOW GET THE LIGHTS
0276 A2 08 LDX #$08 ;AND TREAT THEM THE
0278 2A LITES ROL A ;SAME WAY AS SWITCHES
0279 48 RHA ;EXCEPT OFF=-1
027A A9 2D LDA '-' ;AND ON='*'
027C 90 02 BCC *+4
0280 20 7A E9 JSR OUTPUT ;AUTO-STEP SWITCHES:
0283 68 PLA
0284 CA DEX
0285 D0 F1 BNE LITES
0287 60 RTS
0288 ;
0288 ;AUTO-STEP SWITCHES:
0288 ;
0288 A2 00 AUTO LDX #$00 ;ASK FOR NO. OF SWITCHES
028A 20 F0 E9 JSR CRLF
028D BD 01 00 PRMSG LDA MSG,X
0290 20 7A E9 JSR OUTPUT
0293 88 INX
0294 E0 12 CPX #$12
0296 D0 F5 BNE PRMSG
0298 20 3C E9 CNVRT JSR READ ;GET ANSWER
0298 38 SEC ;MAKE ASCII INTO VAL
029C E9 30 SEC #$30
029E 30 F8 BMI CNVRT
02A0 C9 09 CMP #$09
02A2 10 F4 BPL CNVRT
02A4 AA TAX
02A5 A9 00 LDA #$00 ;AND TREAT AS BEFORE,
02A7 38 FCNT SEC ;WITH TOGGLE
02A8 2A ROL A
02A9 CA DEX
02AA D0 FB BNE FCNT
02AC AA TAX ;USE X FOR COMPARES
02AD A9 00 LDA #$00 ;INITIALLY ALL
02A9 BD 01 A0 STA PORTA ;SWITCHES ARE OFF
02B2 8A STEP TXA ;SAVE X
02B3 48 RHA
02B4 20 52 02 JSR STATE ;DISPLAY STATES
02B7 68 PLA ;AND GET X BACK
02B8 AA TAX
02B9 AD 11 A4 LDA PRIFLG ;SEE IF PRINTER IS ON
02BC 2A ROL A ;AND SKIP DELAY IF SO
02BD B0 12 BCS DONE
02BF A0 00 LDY #$00 ;3/4 SECOND DELAY
02C1 A9 71 DELAY LDA #$71
02C3 8D 08 A0 STA T2L
02C6 A9 0B LDA #$0B
02C8 8D 09 A0 STA T2I
02CB 20 18 EC JSR TIMER
02CB C8 INY
02CF D0 F0 BNE DELAY
02D1 EC 01 A0 DONE CPX PORTA ;DONE INCREMENTING?
02D4 FO 06 BEQ TOTOP ;IF SO, BACK TO TOP
02D6 EE 01 A0 INC PORTA ;OTHERWISE STEP ONE
02D9 4C B2 02 JMP STEP ;AND DISPLAY & DELAY
02DC 4C 03 02 TOTOP JMP RSTRT
02DF ;
02DF ;
0001 ORG $1
0001 OBJ $800
0001 ;
0001 48 4F 57 MSG ASC 'HOW MANY SWITCHES?'
0004 20 4D 41
0007 4E 59 20
000A 53 57 49
000D 54 43 48
0010 45 53 3F

```

**Listing 2: Sample Output of the Logic Trainer Program**

HOW MANY SWITCHES?

```

00000000 -----
00000001 -----
00000010 -----
00000011 -----
00000100 -----
00000101 -----
00000110 -----
00000111 -----

```

The circuit being checked is an adder with carry-in capability. The inputs ( $C_i, X, Y$ ) are displayed by switches 6, 7, and 8 respectively. The outputs ( $C_o, Z$ ) are displayed by lights 7 and 8.

The user has turned on the printer, chosen the Auto-step command, and asked for three switches.

To single-step the switches, hit the space bar. Switch # 8 will toggle the fastest. To automatically step through any number of switches, type 'A' for auto-step. You will get the message:

#### HOW MANY SWITCHES?

Type a number between 1 and 8 (anything else is ignored). The switches are all reset to '0' and the program puts your circuit through its paces.

There is a  $\frac{3}{4}$ -second delay between steps, which can be changed according to the instructions in table 2. If the printer is turned on, the delay will be skipped. You can use the printer to generate a truth table (see listing 2 for a sample printout).

If you have a different 6502-based system, see table 3 for a list of system references. Any 6502 system can run this program if it has a VIA and at least 20 columns to display.

**Table 4: Application Connector (J1) Wiring**

Pin	Name	Function
A-1	Ground	
A-2	PA3	Switch 5
A-3	PA2	Switch 6
A-4	PA1	Switch 7
A-5	PA4	Switch 4
A-6	PA5	Switch 3
A-7	PA6	Switch 2
A-8	PA7	Switch 1
A-9	PB0	Light 8
A-10	PB1	Light 7
A-11	PB2	Light 6
A-12	PB3	Light 5
A-13	PB4	Light 4
A-14	PA0	Switch 8
A-15	PB7	Light 1
A-16	PB5	Light 3
A-17	PB6	Light 2
A-A	+5V	

My power supply is not the AIM standard and I know I have enough extra current to supply the circuits being tested. But if your supply is running very near its capacity, the milliamps might make a difference. An extra .5 amps should be plenty for most applications.

If you hit an invalid key, the program ignores it. However, the burden of getting the wiring right is entirely on the user. Don't short out the VIA! If you are careful, this program could be a useful tool for hardware development.

Larry Kollar is a senior at Michigan Technological University, majoring in Technical Communications with an option in Computer Science. Upon graduating in May of 1982, he plans to write and revise software manuals. Contact Mr. Kollar at 5500 Greenboro SE, Kentwood, MI 49508.

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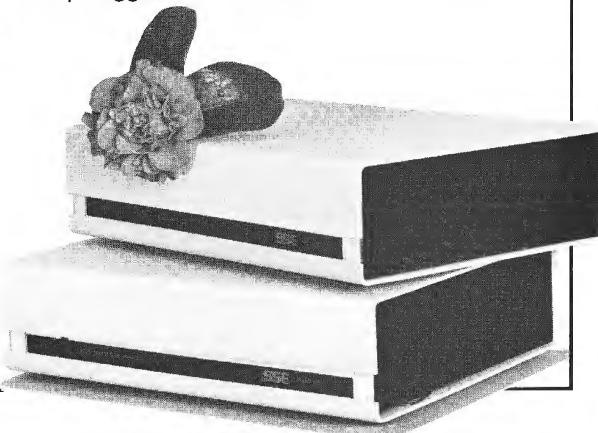
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# A Versatile Disk Label Printer

by David Allen

**This disk label print program includes provisions for one- and two-sided disks, generating a different type of label for each.**

## Disk Label Print Program requires:

Apple II or Apple II Plus  
Applesoft BASIC  
Written for MX-80, but can be adapted to others.

I recently discovered that I had acquired a fairly large number of diskettes with a miscellaneous hodge-podge of programs on them. I finally bit the bullet and spent several hours rearranging them by category on dedicated diskettes. After all this work, I was totally dissatisfied with my diskette labelling system. I found I had a completely uncoordinated label system, with differing sizes, locations, pen colors, and unreliable information about the contents. So, I decided to create a utility program for printing diskette labels. This program is the result.

## Two Kinds of Labels

I know that there are reasons not to record on the back side of a single-sided diskette; I do it anyway. But it was inconvenient to have labels on both sides of the diskette. I needed one label on the front to identify the contents of both front and back. For those less frequent occasions when I leave the back vacant, I can use the full space of the label for just the information for that side. As a result, the program has two distinctly different formats for printing the labels.

## Screen Format of Input

To avoid printing lines too long for the format, I had the program print a video screen format so I could stay inside the lines. A degree of self-centering can be automatically developed.

```

15 REM
FOR USE WITH KONZEN'S
PROGRAM LINE EDITOR LOADED FIRST
SO THAT UPPER/LOWER CASE MAY BE
USED. OTHERWISE CHANGE LINES
3040 AND 3050 TO ELIMINATE THE
'&' COMMAND

20 TEXT : HOME : VTAB 10
30 NS = "APPLE-DISK LABEL PRINTER": GOSUB 1000
40 NS = "FOR 1 7/16 INCH BY 4 INCH LABELS": GOSUB 1000
50 NS = "BY DAVID P. ALLEN": GOSUB 1000
60 NS = "OCTOBER 7, 1981": GOSUB 1000
70 FOR X = 1 TO 1000: NEXT
80 POKE 16368,0:DS = CHR$(13) + CHR$(4):VTS = CHR$(27) +
CHR$(62) + CHR$(202) + CHR$(27) + CHR$(61): REM
VTS PRINTS VERTICAL BAR
IN TRS80 BLOCK CHARACTERS

95 N1$ = "ENTER DATA FOR "
97 N3$ = "LABEL"
98 N2$(1) = "LEFT ":N2$(2) = "RIGHT "
100 F = 1
101 HOME
102 NS = N1$ + N2$(F) + N3$: GOSUB 1000
110 PRINT "LINE #1: _____": PRINT
120 PRINT "LINE #2: _____": PRINT
130 PRINT "LINE #3: _____": PRINT
140 PRINT "LINE #4: _____": PRINT
150 PRINT "LINE #5: _____": PRINT
160 PRINT "LINE #6: _____": PRINT
180 VTAB 2: POKE 36,8: INPUT AS(F)
190 IF LEN (AS(F)) > 13 THEN GOSUB 2010: GOTO 180
200 VTAB 4: POKE 36,8: INPUT BS(F)
205 L = 2
210 IF LEN (BS(F)) > 27 THEN GOSUB 2020: GOTO 200
220 VTAB 6: POKE 36,8: INPUT CS(F)
225 L = 3
230 IF LEN (CS(F)) > 27 THEN GOSUB 2020: GOTO 220
240 VTAB 8: POKE 36,8: INPUT ES(F)
245 L = 4
250 IF LEN (ES(F)) > 27 THEN GOSUB 2020: GOTO 240
260 VTAB 10: POKE 36,8: INPUT FS(F)
265 L = 5
270 IF LEN (FS(F)) > 27 THEN GOSUB 2020: GOTO 260
280 VTAB 12: POKE 36,8: INPUT GS(F)
285 L = 6
290 IF LEN (GS(F)) > 27 THEN GOSUB 2020: GOTO 280
320 VTAB 16
330 NS = "USING DOS 3.3? (Y/N-DEFAULT='YES')": GOSUB 1000
350 GET Y$
360 IF Y$ = CHR$(13) GOTO 400
370 DOSS(F) = "DOS 3.2"
380 GOTO 404
400 DOSS(F) = "DOS 3.3"
404 IF F = 2 THEN GOTO 415
405 HOME : VTAB 10
407 NS = "REVERSE SIDE USED? (Y/N)": GOSUB 1000
409 GET Y$
411 IF Y$ = "Y" THEN F = 2: GOTO 101
415 HOME
420 PRINT DS"PR#1"
423 PRINT CHR$(9) + CHR$(1);: REM

```

(continued)

## APPLICATIONS

```

RESETS PRINTER FLAG FROM
CONTROL-I TO CONTROL-A

425 PRINT CHR$ (27); CHR$ (64);: REM
EPSON RESET COMMAND

427 IF F = 1 THEN GOTO 600
430 PRINT CHR$ (15); CHR$ (27); CHR$ (71);: REM

SETS CONDENSED PRINT
DOUBLE STRIKE

435 PRINT CHR$ (27); "D"; CHR$ (29); CHR$ (32); CHR$ (0);: REM
SETS HORIZONTAL TABS

440 PRINT CHR$ (14); AS(F - 1); CHR$ (20); CHR$ (1)"K": PRINT : PRINT
CHR$ (9); VT$;: PRINT CHR$ (9); CHR$ (14); AS(F); CHR$ (1)"K": THEN 270
PRINT CHR$ (9) VT$; REM

PRINTS FIRST LINE

450 PRINT BS(F - 1);: PRINT CHR$ (9); VT$;: PRINT CHR$ (9); BS(F); REM
PRINTS SECOND LINE

460 PRINT CS(F - 1);: PRINT CHR$ (9); VT$;: PRINT CHR$ (9); CS(F); REM
PRINTS THIRD LINE

470 PRINT ES(F - 1);: PRINT CHR$ (9); VT$;: PRINT CHR$ (9); ES(F); REM
PRINTS FOURTH LINE

480 PRINT FS(F - 1);: PRINT CHR$ (9); VT$;: PRINT CHR$ (9); FS(F); REM
PRINTS FIFTH LINE

490 PRINT GS(F - 1);: PRINT CHR$ (9); VT$;: PRINT CHR$ (9); GS(F); REM
PRINTS SIXTH LINE

510 PRINT CHR$ (14); DOS(F - 1); CHR$ (20); CHR$ (1)"K": PRINT : PRINT
CHR$ (9); VT$;: PRINT CHR$ (9); CHR$ (14); DOS(F); CHR$ (1)"K": REM

PRINTS 'DOS' LINE

550 PRINT CHR$ (27); CHR$ (64);: REM
RESETS PRINTER

560 PRINT DS"PR#0"
570 GOTO 3000
600 PRINT CHR$ (27); CHR$ (69); CHR$ (27); CHR$ (71);: REM

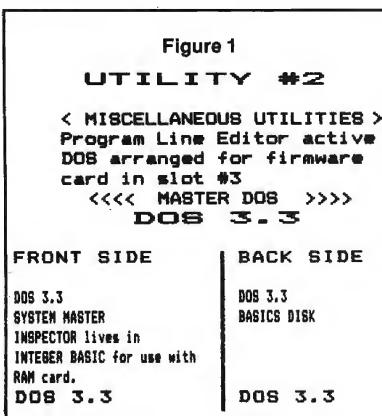
SETS EMPHASIZED PRINT
DOUBLE STRIKE

605 T = INT ((40 - (LEN (AS(F)) * 2)) / 2)
610 PRINT TAB(T) CHR$ (14) AS(F): PRINT : REM
SETS EXPANDED MODE FOR 1ST LINE

620 PRINT TAB(5); BS(F)
630 PRINT TAB(5); CS(F)
640 PRINT TAB(5); ES(F)
650 PRINT TAB(5); FS(F)
660 PRINT TAB(5); GS(F)
680 PRINT TAB(11); CHR$ (14); DOS(F): REM

```

(Continued)



Since I was using an Epson MX-80 printer, I tried to include as much as I could in the label. Different print sizes, double strike, and even some graphics can be used.

Figure 1 shows the final result. The labels are neat and have room for more information than I could ever put on by hand. Here's how the program does it.

I set up a center-justified print routine in line 1000 that I used for the opening billboard and instruction screens. In lines 30-60, for example, I set N\$ equal to the line of information and GOSUB to line 1000 to print it. Line 80 is a housekeeping line that defies the DOS command string and VT\$, which issues the necessary ingredients to print the vertical divider on the two-sided labels. This is formatted for the MX-80 with Graftrax graphics ROMs installed. This line is formed by the TRS-80 graphics characters, which are also available without Graftrax if you know how to access them.

Lines 95-160 set up the video screen with a format to give me the exact length I can use for each of the seven possible label lines. Line 180 and the similar ones following POKE the cursor on the start of the underlined format. You can write a program line, such as 120, with all those underline strokes, even if your Apple doesn't have an underline key in two ways. The easier is Neil Konzen's Program Line Editor, which enables you to print an underline with an 'ESC 3' combination. If you don't have this utility, you can get a line of underscores by executing the following line from the immediate mode:

```
]FOR X = 1 TO 40: PRINT CHR$(95)
;NEXT
```

Lines 180-290 input all the label information into a series to two-element

## APPLICATIONS

string arrays (one element for each side of the diskette). The IF statements examine the length of each line you have typed in. If you have gone longer than the underscored line, it skips down to line 2020 for a new format line. The effect is magically to erase your offending line and put the cursor back at the beginning, waiting for you to try again. Notice 'CALL - 868'. This little-used monitor routine clears the line from the cursor location to the right margin and removes the extra characters which did not fit on the line.

Lines 350-405 tell the program which DOS line we want printed on the bottom of the label. 'F' in line 404 is a flag that we use to determine whether we are printing a single-sided or double-sided label. It is set by the routine in lines 405-411 and sends the program back for another batch of information pertaining to the back side of the diskette, if it is used.

Lines 415-700 offer two different print routines — one for each type of label we might wish to print. All of those 'CHR\$' characters are understood by the MX-80 firmware; your Grafrax manual will help you identify them. If you are using another printer,

```
SETS EXPANDED MODE FOR DOS LINE
690 PRINT CHR$ (27); CHR$ (64);
700 PRINT DS"PR#0"
710 GOTO 3000
1000 T = (40 - (LEN (N$))) / 2: PRINT TAB( T)N$: RETURN
2010 VTAB 2: PRINT "LINE #1: _____";: CALL - 868: RETURN
2020 VTAB (2 * L): PRINT "LINE #";L;"": _____
    :: CALL - 868: RETURN
3000 HOME : TEXT : VTAB 12
3005 N$ = "TO CONTINUE, PRESS <SPACE BAR>": GOSUB 1000
3010 N$ = "TO END, PRESS <RETURN>": GOSUB 1000
3020 X = PEEK ( - 16384)
3030 IF X < > 160 AND X < > 141 THEN GOTO 3020
3040 IF X = 141 THEN & : END
3050 & : RUN
```

you can insert your printer subroutines here in accordance with the protocol for your particular machine.

Lines 3000-end constitute a little routine that lets you sign off gracefully when you are finished with the program. It is simply a matter of reading the keyboard for your instructions and following through (the keyboard strobe was cleared in line 80). Line 3050 is used only if you have Konzen's program line editor to help you. It will permit you to enter your labels in upper and lower case, but PLE gets turned off when the printer slot is invoked in line 420. The '&' command in line 3050 turns PLE back on for use in creating your next label.

### Caution

Never try to scroll label stock *backwards* through your printer in order to save a few unused labels. There is a phosphor bronze pressure plate on the MX-80 which will strip off a back-sliding label and firmly implant it on the inaccessible innards of your printer platen assembly. This can mean an \$80 repair bill to get the label out of the printer and to replace the phosphor bronze spring. Three or four saved labels are obviously not worth that risk.

David Allen may be contacted at 19 Damon Road, Scituate, MA 02066.

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# Program for Inverting a Matrix

by Brian J. Flynn

## Include this short BASIC routine in your mathematical and statistical programs.

Matrix inversion is used in many business and statistical computer programs. For example, econometric techniques ranging from ordinary least squares to multiple linear regression analysis almost always use a matrix inversion routine. This article presents a short BASIC program for inverting a matrix. You can easily make part of it a separate module in one of your bigger programs. The algorithm, Gauss-Jordan Sweep without pivoting (named for mathematicians Carl Friedrich Gauss and Camille Jordan), quickly and accurately inverts most small matrices, when executed in double precision. Other routines, such as Gauss-Jordan Sweep with complete pivoting, generally produce more accurate solutions, but only by sacrificing program simplicity.

### Matrix Inversion

A matrix is a rectangular array of numbers or symbols. Only square matrices can be inverted, with the inverse being that matrix which, when multiplied by the original array, yields an identity matrix. An identity matrix contains 1s along the principal diagonal and 0s everywhere else. The principal diagonal runs like this: " \ ".

In the example in figure 1, matrix X denotes the original array. Its inverse is  $X^{-1}$ , and I is the identity matrix.

The trick of course, is to find  $X^{-1}$ . In the Gauss-Jordan Sweep procedure this is done by tacking an identity matrix onto the original array, and converting the original array into an identity matrix using elementary row and column operations. The right-side matrix that emerges is  $X^{-1}$ . This process is illustrated in figure 2.

Please address correspondence to the author at 1704 Drewlaine Dr., Vienna, VA 22180.

```

100 REM INVERTING A MATRIX USING GAUSS-JORDAN SWEEP, WITHOUT PIVOTING
110 REM
120 REM BY BRIAN J. FLYNN
130 REM NOVEMBER 1981
140 REM
150 REM IF YOUR COMPUTER HAS DOUBLE-PRECISION ARITHMETIC,
160 REM DEFINE ARRAY X AND VARIABLES P AND X AS SUCH
170 REM
180 REM K IS THE SIZE OR ORDER OF MATRIX
190 REM X IS THE DATA MATRIX
200 REM
210 REM INITIALIZATION
220 REM CLEAR SCREEN: PRINT"---PET, HOME--APPLE
230 PRINT"INVERTING A MATRIX USING GAUSS-JORDAN SWEEP, WITHOUT"
240 PRINT" PIVOTING."
250 PRINT
260 PRINT"PLEASE ENTER THE ORDER OF YOUR MATRIX, THAT IS, THE"
270 PRINT" NUMBER OF ROWS OR COLUMNS IN IT. REMEMBER, HOWEVER,"
280 PRINT" THAT ONLY SQUARE MATRICES CAN BE INVERTED."
290 PRINT
300 INPUT"ORDER = ", K
310 DIM X(K,2*K)
320 REM
340 REM ENTER DATA
350 REM
360 FOR I=1 TO K
370 REM CLEAR SCREEN
380 PRINT"PLEASE ENTER YOUR DATA."
390 PRINT"ROW #";I;""
400 PRINT
410 FOR J=1 TO K
420 PRINT"COLUMN #";J;
430 INPUT X(I,J)
440 NEXT J,I
450 REM
470 REM INVERT MATRIX
480 REM
490 REM TACK ON IDENTITY MATRIX
500 REM
510 FOR I=1 TO K
520 FOR J=1 TO K
530 IF J>I THEN X(I,K+J) = 0
540 IF J=I THEN X(I,K+J) = 1
550 NEXT J,I
560 REM
570 REM INVERT MATRIX
580 REM
590 FOR I=1 TO K
600 REM ADJUST KEY ROW
610 P = X(I,I)
620 FOR J=1 TO 2*K
630 X(I,J) = X(I,J)/P
640 NEXT J
650 REM ADJUST REMAINING ROWS
660 FOR J=1 TO K
670 X = X(J,I)
680 FOR L = I TO 2*K
690 IF J>I THEN X(J,L) = X(J,L) - X(I,L)
700 NEXT L,J,I
720 REM
730 REM PRINT MATRIX
740 REM
750 REM CLEAR SCREEN
760 FOR I=1 TO K
770 FOR J=1 TO K
780 REM USE PRINT USING, IF AVAILABLE, INSTEAD OF PRINT
790 PRINTX(I,K+J);","
800 NEXT J
810 PRINT
820 NEXT I
830 PRINT

```

$$\begin{bmatrix} 4 & 1 \\ 6 & 2 \end{bmatrix} \begin{bmatrix} 1 & -\frac{1}{2} \\ -3 & 2 \end{bmatrix} = \begin{bmatrix} 4 \cdot 1 + 1 \cdot (-3) & 4 \cdot (-\frac{1}{2}) + 1 \cdot 2 \\ 6 \cdot 1 + 2 \cdot (-3) & 6 \cdot (-\frac{1}{2}) + 2 \cdot 2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = I$$

Figure 1

To invert  $\begin{bmatrix} 4 & 1 \\ 6 & 2 \end{bmatrix}$  using Gauss-Jordan Sweep, without pivoting, the following steps are performed:

1. Tack an identity matrix onto the original array.

$$\begin{array}{c|c}
 \begin{bmatrix} 4 & 1 \\ 6 & 2 \end{bmatrix} & \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}
 \end{array}$$

2. Convert the original array into an identity matrix using elementary row and column operations.

- a. Divide the entire first row of the matrix by 4, so that the upper left-hand element will equal 1:

$$\begin{array}{c|c}
 \begin{bmatrix} 1 & 0.25 \\ 6 & 2 \end{bmatrix} & \begin{bmatrix} 0.25 & 0 \\ 0 & 1 \end{bmatrix}
 \end{array}$$

- b. Make the numeral 6 a 0 by multiplying the first row by 6 and subtracting the product from the second row:

$$\begin{array}{c|c}
 \begin{bmatrix} 1 & 0.25 \\ 0 & 0.5 \end{bmatrix} & \begin{bmatrix} 0.25 & 0 \\ -1.5 & 1 \end{bmatrix}
 \end{array}$$

- c. Divide the entire second row by 0.5, so that the number 0.5 becomes a 1:

$$\begin{array}{c|c}
 \begin{bmatrix} 1 & 0.25 \\ 0 & 1 \end{bmatrix} & \begin{bmatrix} 0.25 & 0 \\ -3 & 2 \end{bmatrix}
 \end{array}$$

- d. Finally, multiply the second row by 0.25 and subtract the product from the first row:

$$\begin{array}{c|c}
 \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} & \begin{bmatrix} 1 & -0.5 \\ -3 & 2 \end{bmatrix}
 \end{array}$$

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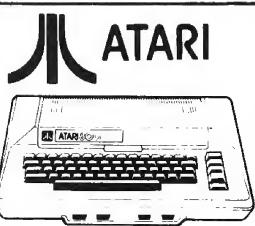
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No. 49 - June 1982



## Reviews in Brief

Product Name: **Olympic Decathlon**  
Equip. req'd: Apple II with 48K  
Price: \$29.95  
Manufacturer: Microsoft Consumer Products  
10700 Northrup Way  
Bellevue, WA 98004

**Description:** Hi-res animation game requiring user competition against other players or against his own previous high scores. The program simulates all events of an actual decathlon. Algorithms for scoring seem well designed.

**Pluses:** Exceptional graphics. Good instructions are provided to teach the user how to play one of the most difficult games on the market.

**Minuses:** Very difficult physically. This game is definitely not for children. Good coordination and timing are required.

**Documentation:** A booklet is provided that includes in-depth instructions. It also gives clues for strategy, a rarity in the market. Grammatically correct and well written.

**Skill level required:** No programming experience required. Good coordination is a must.

**Reviewer:** Chris Williams

Product Name: **Executive Briefing System**  
Equip. req'd: Apple II with Applesoft in ROM or RAM card. One or more disk drives. 48K or RAM memory.  
Price: \$199.00  
Manufacturer: Professional Software Technology Inc.  
180 Franklin Street  
Cambridge, MA 02139  
Authors: Mitchell Kapor and Todd Agulnick

**Description:** Creates and presents a slide show of Apple II hi-res screens. Provides transitions between slides (curtain-up, curtain-down, spiral, dissolve). Adjustable time per slide in automatic or manual change mode. Interrupt feature holds on any slide until ready. Quick manual advance or reverse review, if needed. Automatic shift to alternate disk drive. Automatic program restart. Multiple fonts (type-styles and sizes) with optional additional fonts. Uses VisiCalc-style cursor commands. Can use graphics made outside of program or can create graphics for use outside program.

**Pluses:** Creates separate program diskette which is unprotected and may be copied by any copy program. Has cursor draw mode for making simple borders and separations. Easy type style change in editor. Has bold-face, color, and reverse print options. Optional packed file mode allows many more slides per disk than conventional 34 sector files. Can pack save any standard graphic file. Organizes slide presentation order independent of order in which slides are created. Provides for skipping slides

without deleting them from disk. Has print driver for most popular printers for paper slide copies.

**Minuses:** Inconvenient access to presentation catalog listing during editing. No provision for paper print out of presentation catalog listing. Dissolve transition mode not very neat. Smallest fonts are unreadable on any color screen (but perfectly OK on black and white monitor). No center justification function during slide creation. Master disk is copy protected.

**Documentation:** Excellent 100 plus-page manual provides hand-holding tutorial on complete program. Excellent demo program included called "The Great Conoco Auction," describing last year's take-over of Conoco by DuPont.

**Skill level:** Same skills as other business programs such as VisiCalc, etc. No computer programming skills required.

**Reviewer:** David P. Allen

Product Name: **600 Baud Serial Parallel Converter, p/n PI80C**  
Equip. req'd: TRS-80 Color Computer  
Price: \$69.95  
Manufacturer: The MICRO WORKS  
P.O. Box 1110  
Del Mar, CA 92014

**Description:** The PI80C is a small module slightly larger than a ROMPACK for the TRS-80 Color Computer. It attaches to the Color Computer via a 5-pin DIN plug and cable, and is powered by a wall-plug transformer. The output is a 36-pin card edge compatible with card-edge connectors which implement parallel Centronics-type printer cables. It has a fixed 600 baud data rate, requiring no operator intervention when used with the Color Computer.

**Pluses:** This unit provides a hassle-free interface between the Color Computer and printers requiring a Centronics-type parallel drive. Unlike a few simple shift register interfaces, this device provides transmission of all 7-bit and 8-bit data words, thus allowing full utility of printers requiring special escape codes and other special code sequences to activate special printer attributes.

**Minuses:** The fixed baud rate can be changed by opening the case and adjusting the frequency of the internal oscillator for another baud rate, but this action would void the warranty. Also, no schematic is furnished.

**Documentation:** Entirely adequate for all normal usage; well done.

**Skill level required:** Ability to follow printed instructions. No special techniques are required.

**Reviewer:** Ralph Tenny

(Continued on next page)

## Reviews In Brief (continued)

Product Name: **Tricky Tutorials**  
Equip. req'd: Atari 400/800, 16K Cassette or 24K  
Disk  
Price: \$14.95/tutorial  
Manufacturer: Santa Cruz Educational Software  
5425 Jigger Dr.  
Soquel, CA 95073

**Description:** These programs are designed to instruct programmers in the use of the advanced hardware buried inside each Atari. There are currently five tutorial programs. These programs can be used independently, but to get the most from them they should be studied in order. The six tutorials are: 1. display lists, 2. horizontal and vertical scrolling, 3. page flipping, 4. animation, 5. players/missiles, 6. sound and music. Each tutorial comes complete with a short manual and program media (disk or cassette). More instruction is provided within the programs as you are shown different techniques, the code that produced the display or sound with additional commentary. Suggestions are made for further experimentation and study. The power of immediate feedback with sufficient explanation is not to be underestimated.

**Pluses:** These programs combine the computer with the power inherent in color graphics and sound; this is a most effective and enjoyable learning tool. These programs reinforce information from the difficult-to-understand operating system and hardware manuals that have kept many of us up more than a few nights.

**Minuses:** The material presented is complicated and demands much from the user. The casual viewer will not learn much. Experimentation, asking the "what if" questions, and thinking, are all necessary to getting the most out of this software.

**Documentation:** The initial written documentation was somewhat skimpy. This has been updated and new material added. The entire 6-pack can be purchased in a three-ring binder.

**Skill level:** The material presented requires a comfortable knowledge of BASIC to fully explore all that's presented. Additionally, an enthusiasm for really digging into your Atari would be an advantage.

**Reviewer:** James Capparell

Product Name: **6502 Microcomputer, P/N 80-153**  
Equip. req'd: Single-board microcomputer  
Price: \$119 assembled and tested;  
\$19.95 bare board  
Manufacturer: John Bell Engineering, Inc.  
P.O. Box 338  
Redwood City, CA 94064

**Description:** A single-board computer based on the 6502 microprocessor, using a 6522 VIA as a programmable I/O device, with 1024 bytes of read/write memory and one EPROM socket which can be configured for either a 2716 EPROM or a 2532 EPROM. The board is small (3 1/4" x 4 1/2") and uses a 50-pin edge-card connector. No memory expansion is provided, but 25 unused pins on rear of connector would allow careful expansion within decoder limits. The memory map is decoded to allow 7168 bytes of read/write memory, 256 bytes of I/O beginning at \$1C00, and 52K of EPROM. A 2716 EPROM installed in the existing EPROM socket will be addressed beginning at

\$F800. The result is a controller card with 16 programmable I/O lines, 1K of read/write memory and either 2K or 4K of program memory. An R/C network provides the clock.

**Pluses:** A potentially handy and versatile single-board computer at a fair price.

**Minuses:** The board has a serious, undocumented memory timing error which will cause problems in almost any application that uses read/write memory for anything except a minor amount of scratchpad. The good news is that the fix is almost zero-cost; it requires only an etch cut and a jumper wire. In view of this design error, the assembled and tested product may be over-priced, since the unwary user can lose several hours of time debugging an unreliable and erratic machine. For the informed experimenter, the required etch cut would take only minutes during assembly of the bare board.

**Documentation:** Reasonably complete and well-done; includes some start-up hints and a brief tone generator program listing.

**Skill level required:** The user must thoroughly understand all steps needed to develop a rudimentary monitor and debug a new, untested microcomputer board. He should also be skilled at board assembly, modification, and soldering if the bare-board option is chosen. The manufacturer has a monitor EPROM available, but no details of this are available without direct inquiry.

**Reviewer:** Ralph Tenny

Product Name: **Monkey Wrench**  
Equip. req'd: Atari 800  
Price: \$49.95  
Manufacturer: Eastern House Software  
3239 Linda Drive  
Winston-Salem, N.C. 27106

**Description:** This ROM-based product is designed to be installed in the righthand slot of the 800. It enhances Atari BASIC with nine useful commands: (A) auto line numbering, (D) delete range of lines, (M) change margins, (T) memory test, (R) renumber, (E) cursor key without control key, (\$) hex conversion, (#) decimal conversion, and a machine-language monitor providing another 15 commands. The MLM prompt is a period (.).

**Pluses:** *Monkey Wrench* puts the always empty right slot of the Atari 800 to use. It is designed to be compatible with Atari BASIC. There is room for another ROM on the cartridge and Eastern House is currently working on the new ROM enhancement. This is an excellent development tool.

**Minuses:** The cartridge uses address space \$8000 to \$9FFF. This will reduce your 48K machine to 32K, 8K used by the BASIC cartridge and 8K used by *Monkey Wrench*. This product uses part of page 6 for variable storage which is sure to cause some conflict. Care is needed when inserting the cartridge: it's very easy to put in backwards.

**Documentation:** The manual is short, sweet, and easy to use. A nice example of each function is provided, leaving little to your imagination.

**Skill level required:** This product can be used by any level of BASIC programmer. Serious BASIC users will find it indispensable. I recommend it.

**Reviewer:** James Capparell

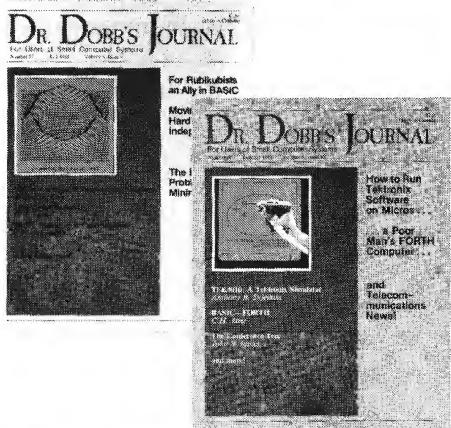
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## PET Vet

By Loren Wright

### A New Disk Cataloging System

Programs, particularly commercial ones, should be easy to use, well-documented, and modifiable enough to meet a wide range of user needs. Terms sometimes used to describe programming of this quality include 'human-engineered' and 'user-friendly.' Many programs purport to be human-engineered or user-friendly, but few actually succeed in meeting all of the necessary criteria.

When a company calling itself "Human Engineered Software" was born last year, I viewed the event with great interest and a little suspicion. Even after I evaluated their first products — HESBAL/HESEDIT, an inexpensive assembler/editor (July 1981 issue) and HESLISTER, a program that produces 'structured' printed listings from a BASIC program on disk (August 1981 issue) — I still had some doubts about the company's ambitious name. HES's recent releases have convinced me that it is worthy of its name.

Besides human engineering, there is another theme to the company's products. All are tools, designed to aid the programmer in coding, debugging, optimizing, and generalizing his programming. One new program, called HES-COUNT, counts the number of times each line of a BASIC program is executed — a seemingly trivial task. When you think about it, this information is very valuable. Lines that never get executed can be eliminated, while lines that are executed many times show themselves as prime targets for optimization efforts.

Another product, called HESCOM, handles transfer of programs and data among different kinds of PETs and VICs. These programs will be reviewed either in this column or in "Reviews in Brief" in the near future. This month's

column is reserved for HESCAT, Human Engineered Software's new disk cataloging system.

My collection of PET disks has grown to include more than 50 disks, and my ability to keep them organized has not kept pace. I keep special types of files on separate disks — WordPro, Wordcraft, HESBAL, MAE, Pascal, RPL, FORTH, and COMAL. It's the rest of the collection that is tough to keep in line. When I'm looking for a program that I haven't used lately, I can usually narrow it down to a few disks; a search of the directories involved will turn up the file in a few minutes. More and more often, though, I just can't seem to find a program, so I waste a lot of time searching. Organizing the disk collection has been on my must-do list for quite a while, but the magnitude of the task has always deferred me. When I received HESCAT for review, I was certainly interested, but I was also a bit apprehensive. Could HESCAT really solve this problem?

I gave HESCAT the ultimate test — my disk collection! The only preliminary step was to separate the 8050 disks from the rest. The system can handle 2040/4040 or 8050 disks, but not both because of the hardware differences.

HESCAT is actually a menu program that loads up the different component programs. There is a 'help' feature that will show you, on request, a brief explanation of each menu option. From the menu you select the 'catalog' option, and then, with your catalog disk in drive 0, you run through your disks one by one in drive 1.

You have to assign each disk a unique 'external ID.' These numbers are maintained separately from the internal IDs — the ones actually written on the disk. They may not be unique, and it is impossible to change them without rewriting the disk. I assigned external IDs according to the order they occurred in my pile, but it would probably be a good idea to make the internal and external IDs the same wherever possible. Cataloging each disk takes about 15 seconds; the exact time depends on how many files are on the disk. Most likely errors are trapped by the catalog program, which advises you to try again. You can recover from an error that causes a break in the program (such as inserting an 8050 disk in a 4040!).

Once you have all your disks cataloged, it is necessary to sort only the file names before you can start using the other programs. The sort is written in machine language and is very fast.

(Continued on page 61)

Figure 1: Portion of 'Headers' Printout

01	"HUMAN ENG SOFTWR"	HT	2	43-FILES	365-FREE	87-ALLOCATED
16	"ATUG ASM#2	"	UE	2	28-FILES	220-FREE
17	"MICRO DISK	"	11	5-FILES	655-FREE	1-ALLOCATED
18	"KMM.M.PASCAL.II.5"	R4	2	6-FILES	534-FREE	6-ALLOCATED
19	"TINYPASCAL-FILES"	40		8-FILES	376-FREE	0-ALLOCATED
20	"NEWFORTH5.0/4.0"	E1	2	2-FILES	33-FREE	456-ALLOCATED
21	"FORTH COPY	"	50	3-FILES	575-FREE	0-ALLOCATED
22	"QUEST PROGS	"	10	14-FILES	545-FREE	0-ALLOCATED
23	"GORDON CAMPBELL"	TF	2	5-FILES	623-FREE	6-ALLOCATED
24	"HES FILES	"	50	16-FILES	559-FREE	0-ALLOCATED
25	"MAE DISK	"	30	15-FILES	450-FREE	0-ALLOCATED
26	"MICRO DISK#4	"	13	3-FILES	593-FREE	-1-ALLOCATED
27	"ASSEM SYSTEM	"	01	44-FILES	74-FREE	0-ALLOCATED

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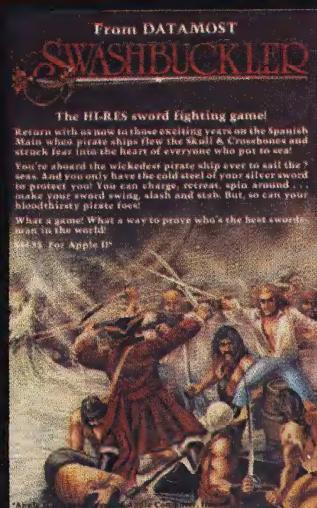
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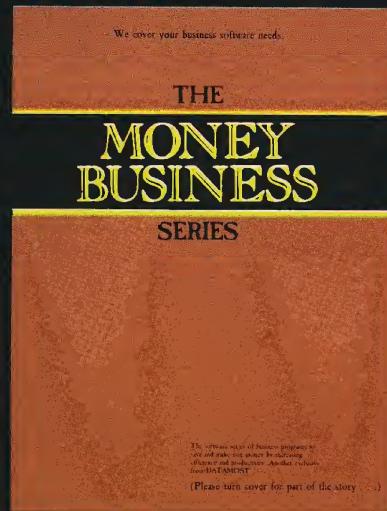
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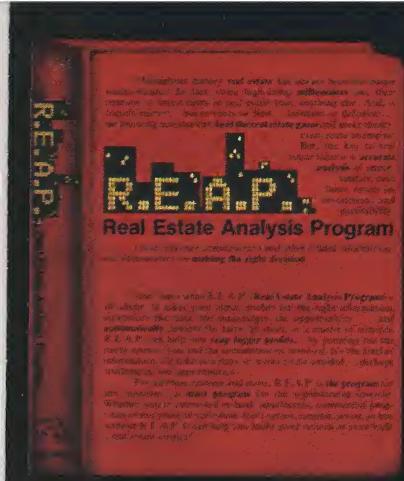
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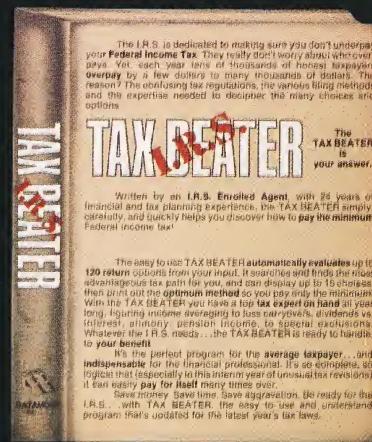
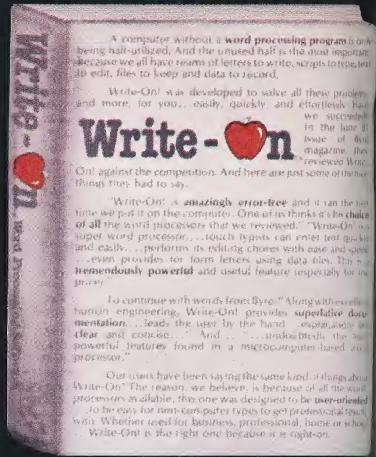


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(Continued from page 60)

Now you can reap the benefits. Probably the most frequent use of the catalog will be to 'locate' a file. The name you give doesn't have to be specified exactly. You can use wild or 'don't care' characters. All file names that meet the criteria are listed, along with their types and disk locations.

From time to time you'll want printed information on your disk files. HESCAT supports CBM, Base2, and Epson MX-80 printers. There are three types of printouts: headers (figure 1), directories (figure 2), and alphabetized names (figure 3). Headers provides summary information about each disk — name, ID numbers, number of files, number of blocks free, and number of direct access blocks allocated. Directories provides a separate directory listing for each disk, and alphabetized names provides all the names in alphabetical order, with file-type and disk number. For each print option you can specify that all disks be included in the listing, or only a specified range.

Updating the catalog is a simple matter. Just enter the 'catalog' program and catalog only the disks whose contents have changed since the last session. The names corresponding to that external ID will be replaced by those for the new contents of the disk. There is also a 'display' program, which is used to view the contents of a sequential file. You will use it occasionally to check the contents of HESCAT files, but it will also come in handy for many other applications. Finally there is a 'user function' option, which can be selected from the menu. There is no function included, but there are many possibilities.

As with the other HES products I've examined, HESCAT is well documented with both a user and a program manual. The program manual includes full listings and descriptions of the functions of all variables. The programs themselves are heavily commented. The most likely change is one to accommodate a printer not supported directly by the program.

I have only one minor complaint. In the cataloging process, you are asked to supply the external ID for a disk before its directory is read. Giving the wrong ID number may accidentally wipe out the file information for a disk already cataloged. The program should check the name and IDs against what already exists in the catalog and give you a chance to confirm your decision to recatalog a disk. This would also help in matching external IDs to the internal ones.

Figure 2: Portion of 'Directories' Printout

25 "MAE DISK		" 30		15-FILES	450-FREE	0-ALLOCATED
P6	KOLBE-PONG2.SRC	P32	KOLBE-PONG.M01RE	P32	KOLBE-PONG.R01	
P33	KOLBE-PONG.SRC	S7	KOLBE-PONG.REL	P5	KOLBE-PONG..	
P1	KOLBE-PONG.CTL	P5	KOLBE-PONG	P32	KOLBE-PONG.M01OL	
P32	KOLBE-PONG.M01	P13	SMITH-PT1.SRC	P5	KOLBE-PONG.O	
P7	KOLBE-PONG.M02	S7	KOLBE-PONG.REL1	P3	SCREENCVT11/3	
26 "MICRO DISK#4		" 13		3-FILES	593-FREE	-1-ALLOCATED
P74	MAIN.4	P1	MOD.4			P3 CODE-MOD.4
27 "ASSEM SYSTEM		" 01		44-FILES	74-FREE	0-ALLOCATED
P6	DOS SUPPORT 4.0	P29	PASC INTERPRETER	P22	FOURIER2	
P10	COPY DISK FILES	S11	SAMPLE.SOURCE	P13	N-SLIT	
P35	EDITASSEM	S3	ROMAN.SOURCE	P4	CALCULATOR	
P36	DISKASSEM	S6	SAMPLE.CODE	P11	SKBLDBRASNEW	
P36	DISKASSEMHI	S2	ROMAN.CODE	P20	MASTERPLOT	
P4	MAC TO BASIC	P15	H-PDMMFREQ	P5	SCREEN DUMP	
P4	MAC TO BASIC HI	P19	BLILOOP	P6	ANOVA1.1	
P14	DISASSEMBLER	P24	R-CPLOTTER	P4	G-STAT	
P7	DISK DUMP	P14	TSEGDM	P10	FLOWCAL2	
P14	HIDISASSEMBLER	P6	THERMOCOUPLE	P21	RFN++	
P10	CROSS	P8	CONDUCTIVITY	P16	1-4 TEMP PLT	
P3	LINK	P12	BLTEMP 4.4	P1	SUSPENSE	
P2	UN-NEWSYS826	P9	LEADBANGER	P1	SCREEN REVERSE	
P22	PASC LED	P5	SQTRFOUR	P35	EDITASSEM8032	
P40	PASC COMPILER	P21	FOURIER1			

Figure 3: Portion of 'Alphabetized Names' Printout

```

P01 G-STAT
S11 GARBAGE
P10 GUESS.PI

P01 H-PDMMFREQ
P12 HEISE-LOADER
P00 HESCAT
P12 HESLIST-SAMPLE
P01 HIDISASSEMBLER
P09 HOUSE-10/24

P10 JEM.ASM
P10 JUMP2
P10 JUMPTABLE
P02 JUSTCPLR

P12 KALEIDOSCOPE
P05 KOLBE-PONG
P15 KOLBE-PONG
P05 KOLBE-PONG-R01
P05 KOLBE-PONG..
P05 KOLBE-PONG.CTL
P05 KOLBE-PONG.M01
P05 KOLBE-PONG.M01OL
P05 KOLBE-PONG.M01RE
P05 KOLBE-PONG.M02
P05 KOLBE-PONG.O
S05 KOLBE-PONG.REL
S05 KOLBE-PONG.REL1
P05 KOLBE-PONG.SRC
P05 KOLBE-PONG2.SRC
P15 KOLBE/P-P
P15 KOLBE/PONG
P12 KOSKI/VECTORS

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# BASIC, FORTH, and RPL

by Timothy Stryker

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**BASIC and FORTH, two widely accepted high-level languages for microcomputers, are compared to RPL, a relative newcomer to the field. The languages are compared with respect to time-efficiency, space-efficiency, transportability, and ease-of-use considerations.**

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Although RPL is currently available only for PET and CBM, this article is of general interest.

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*Editor's Note: Timothy Stryker is the developer of RPL and his company, "Samurai Software" markets RPL for PET and CBM computers.*

BASIC, Beginners' All-Purpose Symbolic Instruction Code, is an excellent language in many respects. It is easy to learn and easy to use. It is very tolerant of user error, which makes the debugging of programs in BASIC a relatively simple matter. Although many different versions of BASIC exist, enough of its features have become standardized to make it reasonably transportable. A BASIC program written on a PET or CBM will generally run on other machines with minor modifications, and *vice versa*.

The main problem with BASIC is its speed. If you have ever tried to write a real-time game or process control program in BASIC, you have no doubt found that it bogs down very easily. PET/CBM BASIC is one of the fastest floating-point BASICs in existence, but there are still many applications for which this BASIC is too slow to be of value. BASIC also consumes prodigious amounts of memory, both for storing user programs and for storing the data to be processed during execution. This can lead to problems with the OUT OF MEMORY error in the course of writing large applications programs.

BASIC's lack of speed has caused many programmers to become interested in FORTH as a widespread language for small computers. Because FORTH usually manipulates numbers in integer form, it gains a significant speed advantage over BASIC (microprocessors can manipulate integers much more quickly than they can floating-point numbers). In addition, FORTH is a "compiled" language, which means faster performance in looking up variables in tables, finding destinations of control-flow branches, and the like. Primarily through the efforts of the "FORTH Interest Group" ("fig") in San Francisco, FORTH has become sufficiently well-known to make possible a reasonable degree of transportability between machines. Unfortunately, FORTH's "extensibility" (its ability to allow the user to add new constructs of all kinds to the language) has led to numerous substantially different flavors of FORTH on the market. Nonetheless, most "fig-FORTH" versions adhere fairly closely to the Interest Group's standards.

The main reason that FORTH has not caught on more strongly is that the language is considerably more difficult to use than BASIC. FORTH operations are ordered according to Reverse Polish Notation, which many people find objectionable. At the same time, the fig-FORTH text editor and its associated disk I/O standards are both unique and cumbersome, which makes FORTH source file management difficult and error-prone. The lack of worthwhile FORTH debugging tools has not helped the situation either: once debugged, FORTH programs tend to be fairly solid, but getting to that point can take a major effort.

In the midst of all this ferment, a new language called RPL has appeared on the scene. RPL, which stands for Reverse Polish Language, is to some extent a combination of BASIC and FORTH. RPL is a compiled language in the same sense that FORTH is. RPL object code is not itself machine code, but

it can be interpreted by a machine-language "run-time executive" that is part of the package. RPL also uses both a parameter stack and a return stack, just like FORTH. However, RPL resembles BASIC in many respects: its implementation on the PET/CBM uses Commodore's BASIC screen editor and all of the normal BASIC source file manipulation commands, like SAVE and DSAVE, LOAD and DLOAD, LIST, DIRECTORY, and so on. This means that RPL programs can be of arbitrary length, without your having to break them up into 1024-byte sections the way you must with FORTH programs. Also, RPL program listings read from top to bottom, just like BASIC listings (which is to say, unlike FORTH listings).

Interestingly enough, RPL is substantially more efficient than FORTH in both space and time in spite of the fact that it is easier to use. Since dedicated FORTHers will no doubt find this hard to believe, I have assembled a few small benchmarks on the CBM 8032 in order to compare BASIC, fig-FORTH, and RPL in terms of their processing speeds and their memory usage.

## The Block-Move Benchmark

Listings 1a, 1b, and 1c show BASIC, fig-FORTH, and RPL implementations of a simple block-move benchmark. The three versions have been kept in as close a correspondence to one another as possible — thus, line 150 of the BASIC version corresponds directly to line 150 of the RPL version and to line 6 of the FORTH version, and so on. Since the routines must appear in bottom-up order in the FORTH version, the symmetry is somewhat broken here, but the BASIC and RPL versions are line-for-line equivalents of one another.

Each benchmark begins by zeroing the 8032's internal timer so that timing measurements can be made. In BASIC, this is accomplished by setting the variable TI\$ to a string of six zeroes, whereas in both FORTH and RPL, this

is done by storing a zero into the word at memory location 142 (the sequence {0 142 !} accomplishes this in both languages).

Then, a 100-pass loop is set up so that the routines to be tested will each be run 100 times. Here we notice the first difference between FORTH and RPL: the RPL version does a {100 1 FOR} to accomplish this, whereas the FORTH version does a {101 1 DO}. RPL's FOR is the equivalent of FORTH's DO, except that in FORTH the upper bound of an iterative loop like this must always be specified as 1 greater than the actual upper bound desired. RPL is more like BASIC in this regard, as you can see.

The body of the loop in each case consists of setting up parameters to be passed to the routine under test, followed by a call to the routine itself. In the BASIC version, setting up of the parameters is accomplished by assigning values to the variables C, T, and F, which in this case specify that the 150 bytes starting at 634 are to be moved up to start at 826. The FORTH and RPL versions of the benchmark, however, expect these arguments to be passed to them on the parameter stack.

A crucial difference between FORTH and RPL is apparent here in the way in which the call itself is done: note that, in FORTH, the simple statement {BLKM} is sufficient to invoke the routine of that name. In RPL, saying simply {BLKM} merely causes the *address* of the BLKM routine to be *pushed onto the stack*: it is the {&} operator (pronounced "call") that actually causes control to be transferred to the routine whose address appears on top of the stack. There are numerous

Listing 1A
<pre> 100 REM **** 110 REM *      BASIC BLOCK-MOVE BENCHMARK 120 REM * ROUTINE AT LINE 1000 MOVES C BYTES FROM F TO T * 130 REM **** 140 REM 150 TIS="000000" : FOR I = 1 TO 100 160 C=150 : T=826 : F=634 : GOSUB 1000 170 NEXT I : PRINT TI;"JIFFIES" : END 1000 M=F-T : FOR J = T TO T+C-1 : POKE J,PEEK(J+M) : NEXT : RETURN </pre>

Listing 1B
<pre> 0 ( **** 1 ( *      FORTH BLOCK-MOVE BENCHMARK 2 ( * BLKM EXPECTS FROM-ADDR ON TOS, THEN TO-ADDR, THEN COUNT * 3 ( **** 4 5 : BLKM OVER - SWAP ROT OVER + SWAP DO DUP I + C@ I C! LOOP DROP ; 6 : TEST 0 142 ! 101 1 DO 7 150 826 634 BLKM 8 LOOP 142 @ INT ." JIFFIES" ; </pre>

Listing 1C
<pre> 100 **** 110 *      RPL BLOCK-MOVE BENCHMARK 120 * THE BLKM ROUTINE EXPECTS FROM-ADDR ON TOS, THEN TO-ADDR, THEN COUNT * 130 **** 140 REM 150 0 142 ! 100 1 FOR 160 150 826 634 BLKM &amp; 170 NEXT 142 @ INT STR\$ PRINT " JIFFIES" PRINT STOP 1000 BLKM: ; - % 3 \$ ; + 1 - % FOR # FN + PEEK FN POKE NEXT . RETURN </pre>

reasons why calls are set up this way in RPL, and we do not have the space here to go into them in any detail. Suffice it to say that the reasons center around space efficiency, speed, and ease of use, all three of which are optimized through the use of this construct. As evidence of this I can only cite the results of the benchmarks given here. These results are almost wholly due to precisely this difference between FORTH and RPL: in FORTH, you call a routine by simply stating its name, whereas in RPL you call a routine by stating its name and then invoking the {&} ("call") operator.

Table 1 shows a few of the RPL operators and their FORTH equivalents. Using this table, you can see that the FORTH and RPL versions of the BLKM routine itself are virtually word-for-word equivalents of one another, the only difference being that, as before, the upper bound of the DO-LOOP in FORTH is 1 greater than the upper bound of the FOR-NEXT in RPL and BASIC. Note that FORTH's {ROT} operator is equivalent to the sequence {3 \$} in RPL: RPL's {\$} operator takes the item on top of the stack and uses it to determine how deep into the stack the rotation process will go.

(Continued on page 66)

Table 1: A few of the RPL operators and their FORTH equivalents (TOS means Top Of Stack; NOS means Next On Stack).

RPL	FORTH	Effects
+	+	Add TOS to NOS, pop TOS
-	-	Subtract TOS from NOS, pop TOS
\	MOD	Take NOS <i>modulo</i> TOS, pop TOS
IF	IF	Begin conditional based on TOS
THEN	ELSE	End THEN-part, begin ELSE-part
END	THEN	End conditional
@	@	Replace TOS with the word it points to
!	!	Store NOS into word pointed to by TOS, pop both
PEEK	C@	Replace TOS with the byte it points to
POKE	C!	Store NOS into byte pointed to by TOS, pop both
#	DUP	Push a new copy of TOS
;	OVER	Push a new copy of NOS
.	DROP	Drop (or pop) TOS
%	SWAP	Swap TOS and NOS
\$		Rotate out TOS'th stack entry onto TOS

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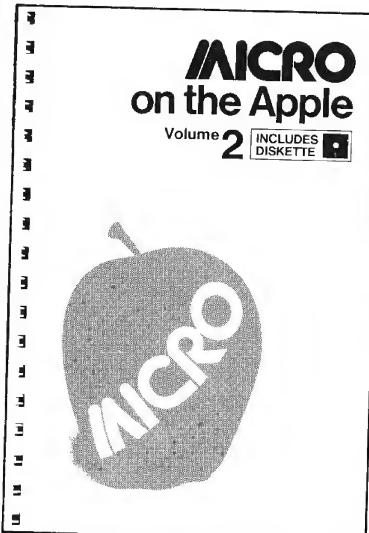
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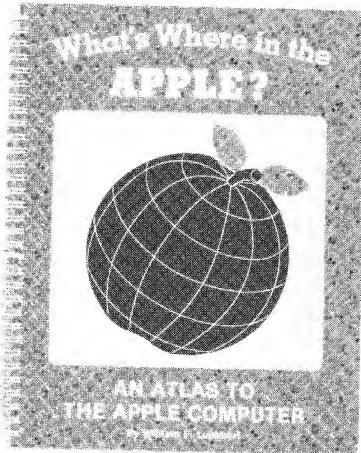
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Once the block-move routine has been executed 100 times, each program then prints out the number of "jiffies" (1/60ths of a second) that have elapsed since it started up. In BASIC, this consists of simply printing out the variable TI. In FORTH and RPL, the contents of location 142 are fetched onto the stack, "byte-interchanged", and printed out. The "byte-interchange" operation {INT} is necessary only because PET/CBM BASIC stores the timer in high-order-byte-first order, whereas both FORTH and RPL expect fetched quantities to appear in the usual low-order-byte-first order in memory.

In the process of printing out the jiffy count and the word JIFFIES, we see another fundamental difference between FORTH and RPL: RPL treats character strings as an elementary data type, whereas standard FORTH does not. The FORTH { } operator both converts the top stack entry to ASCII and prints it out, and FORTH's {'.'} operator unconditionally prints out the character string following it — at no time does fig-FORTH leave a character string sitting on the stack in such a way that the user can get at it. In RPL, character strings representing numbers are frequently placed onto the stack in

Table 2: Results from the Block-Move Benchmark

	Program Bytes	Data Bytes	Jiffies	Figure of Merit
BASIC	115	42	6044	23.23
FORTH	92	0	591	1.82
RPL	57	0	525	1.00

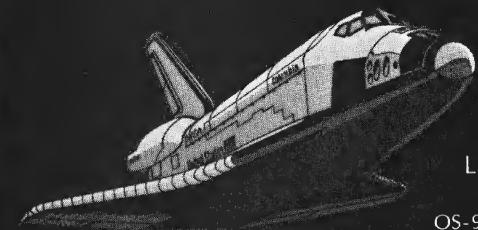
such a way that the user can then manipulate them to any desired purpose, because RPL's {STR\$} operator merely converts the top stack entry to a character string, and the PRINT operator is necessary actually to print the number out. Similarly, when RPL comes across a literal character string enclosed in quotes, it simply pushes that string onto the stack: once the string is on the stack, it may be manipulated further, or, as in this case, immediately printed out using PRINT.

Table 2 displays the results from this first benchmark. In BASIC's case, the "Program Bytes" column does not count REMarks or spaces, but only the actual amount of memory taken up by the code itself. Many programs are

available that compress BASIC code by removing all REMark lines and extraneous blanks, and the figure given here applies to the code size following a compression of this sort. In FORTH and RPL, the size of the object code is of course independent of the number of comments and spaces appearing in the source.

The FORTH and RPL "Program Bytes" entries pertain only to the object code actually generated by the portions of the programs shown in listings 1b and 1c. It should be kept in mind that both of these languages actually incur about one additional K in minimum run-time memory overhead — in FORTH's case, for the so-called "inner interpreter," in RPL's, for the so-called

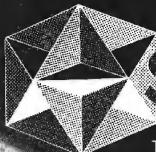
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Each of the three routines of the shuffling procedure operates in basically the same way: the 52-elements array is initialized to the numbers 0 through 51, in sequence, and the order of these elements is then randomized by means of swapping random pairs a total of 200 times. The results of this benchmark are shown in table 3. The astoundingly long time taken by FORTN in this benchmark seems to be largely due to its handling of the MOD function, the innovation of which is internal to my version of the FORTN RND routine. The MOD 8032 takes over 4.5 million seconds to execute, whereas its equivalents to execute, { \ }, takes less than 1.2 milliseconds, worst case. Since the two

Line 145 of the BASIC version, line 150 of the RPL version, and line 1505 of the FORTH version, all accomplish the same thing - each allocation creates space for a 52-element array that will be used to store the same array that occupies memory. In RPL all handling of memory is carried out in just one way, whereas FORTH handles defined symbols differently depending on whether they are symbolic names, constants, etc. RPL's variable names, constants, etc. RPL's otherwise method of specifying what would treat addresses of routines as ordinary symbols: in particular, the ability to swaptrigly powerfully way of handling pictures. Note of the benchmarks marks draw can be very useful in certain situations. Note because neither FORTH nor BASIC has a correspondence capacity along these lines. Note, however, that RPL makes no real distinction between the symbol DECK defined in line 1505 of listing 2c and the symbol SHUFFLE defined in line 1000. Each of them simply takes on a value equal to the address of the object code, and subsequently byte of the object code. The address of the symbol line 1000, which is referred to, simply causes that when pushed onto the para- meter stack at run-time.

signed to test the language, efficient cities at a typical game-related task. Each presentation times 100 passes through a card shuffling, routine, in which any entries of 0 through 51 are used to represent the 52 cards of a normal play. The deck.

Meritt', in table 2 is based around the notion that the overall efficiency of a language is a function of both its time efficiency (speed) and its space efficiency. One fairly common way of combining these two measures of efficiency is to multiply each version's program size by the amount of time it took to execute: the lower this number is, the more efficient the language. In table 2 these figures of merit have been normalized in order to show their ratios to PL.

### The Shutter Benchmark

charge...". If this bothers you at all, consider that, unlike most software, BASIIC does not require a stack for various purposes, and the stack also has a stack that it uses exclusively for various purposes. BASIIC uses memory that is not needed for stack purposes, and the stack marks has not been counted against it in the "Data Bytes", figures either.

### Listing 2c

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## listing 2A

operators yield identical results, it should be recognized that FORTH's poor performance in this benchmark is not primarily a function of anything inherent in the language itself, but is largely due to the speed of the modulo algorithm chosen by the FORTH Interest Group.

### The Falling-Tone Benchmark

Listing 3 contains BASIC, FORTH, and RPL versions of a benchmark designed to test the languages in terms of general logical and arithmetic manipulations, including comparisons, conditional branching, and memory accesses. Each program times itself doing 100 calls to a routine that generates a falling whistle on the 8032's internal speaker. The method used to generate the falling whistle is based on the "VDC" algorithm (see the 10/81 issue of *BYTE*, p. 391). Each octave drop in pitch takes the same amount of time, regardless of whether the octave is toward the top of the range or toward the bottom (the same cannot be said of the obvious "FOR I=1 TO 255:POKE 59466,I:NEXT" in BASIC).

This benchmark brings out yet another major difference between RPL and FORTH. First of all, note that in the BASIC version of the benchmark, a "conditional-within-a-conditional" (in line 1030) takes control out of the loop in lines 1020-1050 if the condition is met. There is every reason to suppose that this is a perfectly "structured" thing to do: only if the first condition (in line 1020) is not met will we determine whether or not it is time to exit the loop. FORTH, however, does not permit this kind of construct. One may set up a BEGIN...WHILE...REPEAT loop in FORTH, but the WHILE operator may not appear within the bounds defined by an IF...THEN pair within the loop. This is restrictive, to say the least, and in an application like this one it unavoidably leads to slower code. The best I could do to get around this in FORTH was to place the WHILE test *outside* the main conditional clause, which meant that it got executed on *every* pass through the loop, regardless of whether or not it needed to be. RPL, being much more like BASIC in this regard, is able to get around this problem through the use of

a GOTO (horrors!). This naturally opens Pandora's Box as far as hard-core structured-programming people are concerned. Suffice it to say that I feel that the real value of structured programming lies in its concern with modularization and clean, well-thought-out software design, not in terms of myopic, over-applied dogmas such as "No GOTOs!" and "No Multiple Entry Points!", etc.

Table 4 shows the results from this third benchmark. It should be clear from these various figures that FORTH is more efficient than BASIC at handling the kinds of tasks shown here, and that RPL is even more efficient than FORTH at these types of tasks, by perhaps a factor of two overall.

### Other Tradeoffs

Ease of use is a very important criterion in determining the real utility of a language. BASIC is the acknowledged leader in this area, at least as far as "quick-and-dirty" programming is concerned. One of BASIC's best qualities is the interactive nature of its pro-

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gram debugging facilities: the BASIC programmer has the option of halting his program at any point so that he can examine variables of interest, etc., and execution can then be continued from where it left off. FORTH has similar debugging tools, but their utility is blunted somewhat due to the opaque nature of the FORTH stacks, not to mention the clumsiness of FORTH's editing, source file handling, and so on. RPL solves this problem by providing a "symbolic debugger" as a separate utility program that allows any RPL program to be debugged via single-stepping, breakpointing, and the like. And the entire contents (up to 18 entries deep) of both the parameter stack and the return stack are available for viewing at any time.

"Extensibility," or the ability of the language to be augmented by the user, is one area in which FORTH shines brightly. Two distinct capabilities of FORTH here are sometimes lumped together in reviews of the subject. One is that normal FORTH routines, once defined, become as though part of the language itself. This feature is really no different in principle from the conventional method of subroutine calling used in other languages. The other capability is much more intriguing: the {< BUILDS >} and {DOES >} operators give the FORTH user the ability to effectively modify the FORTH compiler on the fly, so that whole new language constructs can be created. No other language I know of (with the possible exception of Ada) has this feature. How desirable this is, to many people, remains to be seen: the benefits accruing to it must certainly be balanced against the code obscurity and tendency toward destandardization resulting from it. For example, the same capability is implemented in some FORTH versions as BEGIN...IF...WHILE, in some as WHILE...PERFORM...PEND, and in some as BEGIN...WHILE...REPEAT.

It is in the area of transportability that BASIC and FORTH find their strongest advantage over RPL. RPL is presently available only for the Commodore PET and CBM series of machines, whereas BASIC and FORTH have both become widespread. Every new language, though, goes through a period of limited transportability in its early stages. If the language really does present worthwhile advantages over existing languages, it will eventually be adapted to run on systems other than the one on which it was developed. In fact, Samurai Software is now actively

#### Listing 3A

```
100 REM ****
110 REM *          BASIC FALLING-TONE BENCHMARK
120 REM * ROUTINE AT LINE 1000 GENERATES CB2 TONE WITH EXPONENTIAL FALLOFF *
130 REM ****
140 REM
150 TI$="000000" : FOR I = 1 TO 100
160 GOSUB 1000
170 NEXT I : PRINT TI;"JIFFIES" : END
1000 POKE 59464,0 : POKE 59467,16 : POKE 59466,170
1010 DY=20 : DC=0
1020 IF DC>0 THEN 1050
1030 DY=DY+1 : IF DY=256 THEN 1060
1040 DC=DC+256 : POKE 59464,DY
1050 DC=DC-DY : GOTO 1020
1060 POKE 59467,0 : POKE 59466,0 : RETURN
```

#### Listing 3B

```
0 ( ****
1 ( *          FORTH FALLING-TONE BENCHMARK
2 ( * THE TONE ROUTINE GENERATES CB2 TONE WITH EXPONENTIAL FALLOFF *
3 ( ****
4
5 : TONE 0 59464 C1 16 59467 C1 170 59466 C1
6 20 0
7 BEGIN DUP 0< IF
8 SWAP 1+
9 SWAP 256 + OVER 59464 C1 THEN OVER 256 < WHILE
10 OVER - REPEAT
11 DROP DROP 0 59467 C1 0 59466 C1 ;
12 : TEST 0 142 1 101 1 DO
13 TONE
14 LOOP 142 @ INT . ." JIFFIES" ;
```

#### Listing 3C

```
100 ****
110 *          RPL FALLING-TONE BENCHMARK
120 * ROUTINE AT LINE 1000 GENERATES CB2 TONE WITH EXPONENTIAL FALLOFF *
130 ****
140 REM
150 0 142 ! 100 1 FOR
160 TONE &
170 NEXT 142 @ INT STR$ PRINT " JIFFIES" PRINT STOP
1000 TONE: 0 59464 POKE 16 59467 POKE 170 59466 POKE
1010 20 0
1020 LOOP: # 0 < IF
1030 % 1 + # 256 = IF . . THATSIT GOTO END
1040 % 256 + ; 59464 POKE END
1050 ; - LOOP GOTO
1060 THATSIT: 0 59467 POKE 0 59466 POKE RETURN
```

Table 3: Results from the Shuffler Benchmark

	Program Bytes	Data Bytes	Jiffies	Figure of Merit
BASIC	179	367	48175	23.15
FORTH	117	54	15136	4.75
RPL	70	52	5321	1.00

Table 4: Results from the Falling-Tone Benchmark

	Program Bytes	Data Bytes	Jiffies	Figure of Merit
BASIC	219	21	63701	32.54
FORTH	150	0	5764	2.02
RPL	96	0	4466	1.00

seeking individuals who would be interested in adapting RPL to the Apple, the TRS-80, CP/M, and so on. Would you, by any chance, be interested?

Timothy Stryker may be contacted at Samurai Software, P.O. Box 2902, Pompano Beach, FL 33062.

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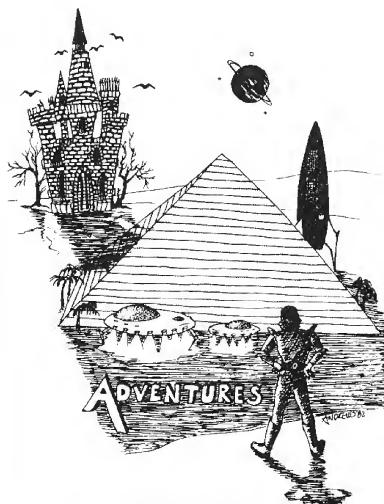
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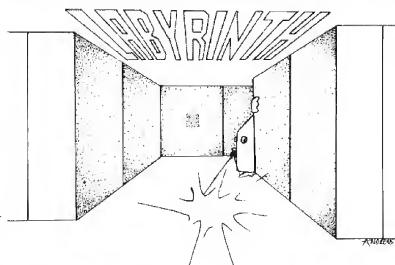
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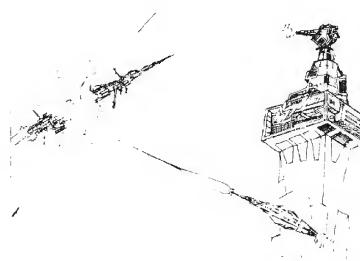
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by Jim Strasma and John O'Hare

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8K or larger  
O.S. 2.0

This PET version of PILOT, like its parallel program on the SYM, isn't as full a PILOT as the version sold by Apple Computer Co. However, it is a good start, and you can develop it into something very impressive, given a bit of time.

If you'd rather not type in this lengthy listing, and have either the ASM/TED or MAE assembler and a CBM disk, contact the ASM/TED Users' Group (ATUG) librarian, Brent Anderson, for disk 'UE'. If your copy of ASM/TED can't read MAE disk files, include your ASM/TED serial number from the front of your manual as proof of purchase, and ask for the disk containing "MOSER". Write to ATUG at 200 South Century, Rantoul, IL 61866.

## For the Adventurous

There is a way to disable the "crunch" routine in PET BASIC that makes the quotation mark necessary at the start of each line of PILOT. Like the routine that disables the PET's [stop] key, it merely jumps three bytes beyond the usual entry point in BASIC when inserting a new line into a program. In BASIC 4.0, the usual entry is at \$B419 and the needed value is \$B41C.

This technique is used in the Editor of CBM's 6502 development program disk. But the patch must be initialized before beginning work on a PILOT program. With that in mind, you may prefer to keep using the quote marks.

**Table 1: PET TINY PILOT**

PET TINY PILOT is based on an original program for the SYM computer, by Nick Vrtis. The PET conversion and extensions are by John O'Hare, aided by Jim Strasma.

### PET TINY PILOT Program Statements

T:TEXT	Display the text on screen
A:	Input up to 40 characters into the answer field
?:	Input up to 40 characters into both the name and answer fields
TEXT	Compare text to last input and set yes/no flag
J:N	Jump to label N for next line
J:A	means jump to last accept
J:*	means restart program
U:N	Use subroutine labeled N
S:	Stop program and return to edit mode
C:	Compute, performs "+", "-", and "=" on variables "A"- "Z"
R:	Remarks — are not executed
P:X	Put a random number between 1 and 99 in variable "X" (Call three times at the start of your program to initialize correctly. Otherwise, result may be outside correct range.)
I:X	Input number into variable "X"
L:F-Z	Call machine-language routine
L:A	Clear screen
L:B	Reverse screen foreground and background
L:C	Scroll up
L:D	Scroll down
L:E	Home cursor to top left of screen
L:F	Use machine-language program in second cassette buffer address 826 (Do not use "L:G" through "L:Z" as commands. They are reserved for future features, and will crash your program if used.)
F:U	Set to graphic mode (upper-case)
F:L	Set to text mode (lower-case)
D:	Delay about five seconds
W:	Wait for key to be pressed
Conditionals	(May precede any statement. Execution only if condition satisfied.)
Y	Execute if match flag = Y
N	Execute if match flag = N (i.e. YT:TEXT, NJ:N)
Label	
*A	Labels current location 'A'
Variables within Text	Causes contents of named variable to be matched or displayed
\$?	Same as \$X — applies to Name field

## Notes on TINY PILOT

### Getting It Working

The interpreter's object code is located at addresses \$7800 through \$7F91 hex. This version is for PET or CBM computers with BASIC 2.0 (sometimes called 3.0) only. BASIC 1.0 and 4.0 versions are feasible, but have not yet been attempted. If you wish to do the conversion, we recommend getting a copy of the source code from the ASM/TED Users' Group.

Users with the upgrade BASIC 2.0 ROMs may either type in PET TINY PILOT from the hex listing in this article, or request it on disk from ATUG.

### Writing Programs

PET TINY PILOT programs are keyed in like a BASIC program, but each line number must be followed by a single quotation mark:

```
10 "T:TINY PILOT TEST
20 "S:
```

After loading TINY PILOT from BASIC like any other program, enter "new:

sys32512". This is important! Without the "new", PET will think you are out of memory. And without the "sys" call, Tiny PILOT will not be protected from BASIC.

Once the TINY PILOT program has been loaded and initialized, TINY PILOT programs may be loaded, saved, edited, and listed just like PET BASIC programs, using the usual syntax. They may even be written, edited, and saved without PET TINY PILOT loaded. To run a program, simply type SYS30721.

### Using the Match (M:) Statement

"M:YE,SURE will match with "YES", "YEP", "SURE", and "SURELY", but not with "YA", "SUROUND", or "NO".

### Example Match Formats:

M:YES,,YA,OK  
M:NO  
M:- (Checks for a negative number)

PILOT has two special error messages:

1. ERR, with the specific error listed here;

2. X LABEL NOT FOUND, where X is a TINY PILOT label.

### Sample Program

```
10 "R:GUESS PROGRAM
20 "P:R
30 "T:GUESS MY NUMBER (999 TO QUIT)
40 "*LT:YOUR GUESS
50 "I:G
60 "C:$=G
70 "M:999
80 "YT:OK
90 "YJ:E
100 "C:N=R-G
110 "C:$=N
120 "C:S=S+1
130 "M:0
140 "YT:YOU GOT IT!
150 "YJ:E
160 "M:-
170 "YT:TOO BIG
180 "NT:TOO SMALL
190 "T:
200 "J:L
210 "*ET:IT TOOK $S GUESSES
220 "T:
230 "T:MY NUMBER - $R
240 "S:
```

Contact Jim Strasma at P.O. Box 647, Pawnee, IL 62558. Write to John O'Hare at P.O. Box 157, Lemont, IL 60439.

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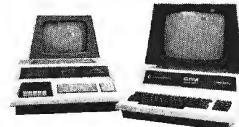
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**MICRO**, Dec. '81, p. 35  
**MICROCOMPUTING**, Feb. '82, p. 10  
**MICRO**, Mar. '82, p. 29  
**BYTE**, Mar. '82, p. 476  
**COMPUTE!**, Mar. '82, pp. 45, 120.

See also the article "**Basic, Forth and RPL**" in the June '82 issue of **MICRO**, and Mr. Bressler's review in the Jan./Feb. '82 issue of *The Paper*. Don't let our prices deceive you: **RPL** is a first-class, high performance language in every respect. We are keeping its price so low in order to make it accessible to the widest possible number of users. Only **\$80.91**, postpaid, for both the **RPL** compiler and its associated symbolic debugger, complete with full documentation (overseas purchasers please add \$5.00 for air mail shipping). Versions available for PET-2001 (Original, Upgrade or V4.0 ROM's), CBM 4032, and CBM 8032/8096, on cassette, 2040/4040, and 8050 disk.

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**Tiny PILOT Listing**

7800 EA R9 00 80 8A 7D 20 ED  
 7808 7B A2 33 A9 00 8D 85 7D  
 7810 9D 42 7D CA 10 FA A5 97  
 7818 C9 04 D0 03 4C 89 C3 B1  
 7820 88 B1 88 C9 2A D0 04 C8  
 7828 C8 D0 EB C9 59 F0 04 C9  
 7830 4E D0 12 CD F1 7C F0 F0  
 7838 20 BF 7B RD 8A 7D F0 03  
 7840 4C 89 C3 B0 D1 8D 76 7D  
 7848 C8 C9 4C D0 14 20 B6  
 7850 7C 20 02 7C 8A RA EA  
 7858 E0 01 D0 09 20 29 E2 4C  
 7860 88 78 4C D3 78 E0 02 D0  
 7868 18 A2 80 A0 00 84 20 86  
 7870 21 B1 20 49 80 91 20 C8  
 7878 D0 F7 E8 E0 84 D0 F0 F0  
 7880 07 E0 03 D0 09 20 3F E5  
 7888 20 C8 7C 4C 38 78 E0 04  
 7890 D0 29 A0 28 84 22 A0 00  
 7898 84 20 A0 BF A2 83 86 21  
 7899 86 23 B1 20 91 22 88 C0  
 78A0 FF D0 F7 CA E0 7F D0 EE  
 78B0 A0 27 A9 20 91 20 88 10  
 78B8 FB 30 CD E0 05 D0 08 A9  
 78C0 13 20 D2 FF 4C 88 78 E0  
 78C8 06 D0 06 20 3A 03 4C 88  
 78D0 78 A9 4C C9 50 D0 06 23 20  
 78D8 02 7C 8E 86 7D F8 38 A5  
 78E0 55 65 58 65 59 85 54 A2  
 78E8 04 B5 54 95 55 CA 10 F9  
 78F0 D8 RE 86 7D 90 43 7D 4C  
 78F8 38 78 C9 49 D0 42 A9 3F  
 7900 20 RA 7C A9 00 8D 78 7D  
 7908 80 79 7D 20 8C 7C C9 00  
 7910 F0 19 38 E9 30 A2 04 18  
 7918 0E 79 7D 2E 78 7D CA 00  
 7920 F6 18 60 79 7D 80 79 7D  
 7928 4C 0B 79 20 82 7C RD 78  
 7930 7D 9D 42 7D AD 79 7D 9D  
 7938 43 7D 20 A1 7C 4C 38 78  
 7940 C9 46 D0 1D B1 88 80 89  
 7948 7D C9 55 D0 08 A9 8C 8D  
 7950 4C E8 4C 38 78 RD 89 7D  
 7958 C9 4C D0 F6 A9 8E 4C 4F  
 7960 79 C9 44 D0 0E A9 00 85  
 7968 8F 85 8E A5 8E C9 01 D0  
 7970 F0 F0 DF C9 57 D0 10 20  
 7978 B6 7C 20 E4 FF C9 00 F0  
 7980 F9 20 C8 7C 4C 38 78 C9  
 7988 3F D0 06 38 C6 76 7D 00  
 7990 0E C9 41 D0 39 R5 88 8D  
 7998 EF 7C A5 89 8D F0 7C A9  
 79A0 3F 20 RA 7C A2 27 20 8C  
 79A8 7C C9 14 D0 03 E8 D0 F6  
 79B0 C9 0D D0 02 A9 00 9D F2  
 79B8 7C 2C 76 7D 10 03 90 1A  
 79C0 7D C9 00 F0 03 CA 10 DE  
 79C8 20 A1 7C 4C 38 78 C9 43  
 79D0 F0 03 4C 7D TA 20 02 7C  
 79D8 8E 7C 7D A9 00 8D 7A 7D  
 79E0 8D 7B 7D C8 A2 2B D0 59  
 79E8 C8 B1 88 30 22 C9 2F 90  
 79F0 1E C9 3A B0 14 29 0F 6A  
 79F8 6A 6A 6A A2 04 2E 79 7D  
 7A00 2E 78 7D 0A CA D0 F6 F0  
 7A08 DF 20 0A 7C 4C E8 79 F8  
 7A10 RA RD 7E 7D C9 2D F0 16  
 7A18 18 AD 79 7D 60 7B 7D 80  
 7A20 7B 7D AD 78 7D 60 7A 7D  
 7A28 8D 7D 7D 4C 41 TA 38 AD  
 7A30 7B 7D ED 79 7D 80 7B 7D  
 7A38 AD 7A 7D ED 78 7D 80 7A  
 7A40 7D 08 8E 7E 7D 8A F8 0C  
 7A48 30 0A R9 00 8D 78 7D 80  
 7A50 79 7D F0 94 AE 7C 7D 10  
 7A58 15 A2 38 20 0D 7C 20 10  
 7A60 7C A2 04 8D 7F 7D 90 15  
 7A68 7D CA 10 F7 30 0C AD 78  
 7A70 7D 9D 43 7D AD TA 7D 9D  
 7A78 42 7D 4C 38 78 C9 4D D0  
 7A80 57 88 C8 A2 27 B1 88 F0

**Tiny PILOT Listing (continued)**

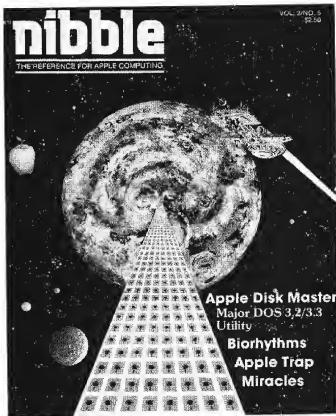
7A88 09 D0 F2 7C D0 08 C8 CA  
 7A90 10 F3 A2 59 D0 3D C9 24  
 7A98 F0 14 C9 2C F0 F4 C8 B1  
 7AA0 88 F0 2E C9 2C F0 D8 D0  
 7AAB F5 AC 77 7D D0 F0 C8 SE  
 7AB0 7C 7D 20 1A 7C AE 7C 7D  
 7AB8 8C 77 7D A0 04 B9 7F 7D  
 7AC0 F0 09 D0 F2 7C D0 E2 CA  
 7AC8 88 10 F2 AC 77 7D C8 D0  
 7AD0 B4 A2 4E 8E F1 7C D0 A2  
 7AD8 C9 55 D0 1B B1 88 48 20  
 7AE0 BF 7B AD 8A 7D F0 03 4C  
 7AE8 89 C3 A5 88 8D 84 7D A5  
 7AF0 89 8D 85 7D 68 D0 06 C9  
 7AF8 4A D0 50 B1 88 8D 76 7D  
 7B00 C3 2A F0 40 C9 41 D0 0E  
 7B08 AD EF 7C 85 88 AD F0 7C  
 7B10 85 89 A0 00 68 20 F0  
 7B18 7B B1 88 C9 2A D0 08 C8  
 7B20 B1 88 CD 76 7D F0 20 20  
 7B28 8F 7B AD 8A 7D F0 13 AD  
 7B30 76 7D 28 AA 7C A0 7F A9  
 7B38 7E 20 1C CA 20 A1 7C 4C  
 7B40 89 C3 B0 D5 4C 06 78 C8  
 7B48 4C 7E 7B C9 53 D0 03 4C  
 7B50 89 C3 C9 45 D0 15 AD 85  
 7B58 7D F0 14 85 89 D0 84 7D  
 7B60 85 88 A0 00 A9 00 8D 85  
 7B68 7D F0 13 C9 52 D0 03 4C  
 7B70 38 78 C9 54 F0 05 88 88  
 7B78 20 07 7C 20 89 7B AD 8A  
 7B80 7D F0 03 4C 89 C3 4C 16  
 7B88 78 B1 88 F0 2F C9 24 D0  
 7B90 24 C8 B1 88 C9 3F F0 10  
 7B98 20 1A 7C A2 04 B0 7F 7D  
 7BA0 F0 16 20 RA 7C CA 10 F5  
 7BA8 A2 27 BD 1A 7D F0 09 20  
 7BB0 RA 7C CA 10 F5 20 RA 7C  
 7BB8 4C 8C 89 7B 20 A1 7C B1  
 7BC0 88 F0 04 C8 4C BF 7B C8  
 7BC8 B1 88 C8 11 88 D0 06 A9  
 7BD0 01 8D 8A 7D 60 C8 C8 C8  
 7BD6 B1 88 C9 22 D0 01 C8 98  
 7BE0 18 65 88 85 88 90 02 E6  
 7BE8 89 A0 00 38 60 20 A1 7C  
 7BF0 A0 01 84 88 6C EF 7C A9  
 7BF8 04 85 89 8D F0 7C A0 FF  
 7C00 D0 C5 B1 88 38 E9 41 0A  
 7C08 RA 60 20 02 7C BD 43 7D  
 7C10 8D 79 7D 80 42 7D 80 78  
 7C18 7D 60 20 0A 7C 10 1C A9  
 7C20 2D 8D 83 7D F8 38 A9 00  
 7C28 ED 79 7D 80 79 7D A9 00  
 7C30 ED 78 7D 8D 78 7D D8 A2  
 7C38 03 D0 02 A2 04 18 6E 7D  
 7C40 7D AD 78 7D 20 63 7C 00  
 7C48 79 7D 4A 4A 4A 20 63  
 7C50 7D AD 79 7D 20 63 7C 20  
 7C58 7D 7D 30 01 CA A9 00 90  
 7C60 7F 7D 60 29 89 00 30 90  
 7C68 7F 7D 2C 7D F0 30 05 C9  
 7C70 3D D0 01 60 38 6E 7D 7D  
 7C78 CA 60 C9 03 D0 03 4C 89  
 7C80 C3 C9 93 D0 22 A9 3E 20  
 7C88 RA 7C A0 00 20 B6 7C 20  
 7C90 E4 FF 20 02 FF 8D 89 7D  
 7C98 20 C8 7C C9 00 F0 ED D0  
 7CA0 D9 20 B6 7C 20 E2 C9 4C  
 7CA8 C8 7C 20 B6 7C 20 D2 FF  
 7CB0 8D 89 7D 4C C8 7C 8C 87  
 7CB8 7D 8E 86 7D 8D 89 7D 08  
 7CC0 68 8D 88 7D AD 89 7D 60  
 7CC8 AC S7 7D AE 86 7D AD 88  
 7CD0 7D 48 AD 89 7D 28 60 A9  
 7CD8 45 20 RA 7C A9 52 20 AA  
 7CE0 7C 20 RA 7C 20 20 RA  
 7CE8 7C A9 01 8D 8A 7D 60 1D  
 7CF0 1D 10 11 20 2D 32 2D 32  
 7CF8 1D 1D 1D 1D 1D 1D 11 11  
 7D00 20 2D 32 2D 32 10 1D 10  
 7D08 1D 1D 11 11 11 11 11 11

**Tiny PILOT Listing (continued)**

7D10 11 11 20 2D 32 2D 32 1D  
 7D18 1D 1D 10 10 11 20 2D 32  
 7D20 20 32 10 1D 11 11 11 11  
 7D28 20 2D 31 1D 10 1D 10 1D  
 7D30 1D 10 11 11 11 20 2D 31  
 7D38 20 31 1D 10 11 20 2D 31  
 7D40 20 31 1D 10 10 10 10 10  
 7D48 11 11 11 11 11 11 11 20  
 7D50 20 31 1D 10 10 10 10 10  
 7D58 1D 10 1D 11 11 11 20 2D  
 7D66 31 2D 31 1D 10 1D 10 11  
 7D68 11 11 11 11 11 11 11 20  
 7D70 20 30 20 30 10 10 10 11  
 7D78 11 20 20 30 20 30 1D 10  
 7D80 10 11 11 11 20 20 30 20  
 7D88 30 10 10 1D 11 11 11 11  
 7D90 11 11 11 20 20 30 20 30  
 7D98 30 10 10 1D 10 10 10 10  
 7DA0 1D 11 11 20 20 30 20 30  
 7DRA 1D 11 11 11 11 11 11 20  
 7DDB 20 30 20 30 1D 10 1D 10  
 7DDE 1D 10 1D 11 11 11 11 11  
 7DDE 1D 10 1D 10 11 11 11 11  
 7DFF 11 20 20 31 20 31 1D 10  
 7DFF 1D 10 1D 11 11 11 11 11  
 7DFF 1D 11 20 20 31 20 31 1D  
 7DFF 1D 11 20 20 31 20 31 1D  
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 7DFF 1D 11 20 20 32 20 32 1D  
 7E00 11 11 20 20 32 20 32 1D  
 7E08 11 11 20 20 32 20 32 1D  
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 7E18 11 20 20 32 20 32 1D 10  
 7E20 11 11 11 11 11 11 11 11  
 7E28 20 20 32 20 32 1D 10 1D  
 7E30 1D 1D 11 11 11 11 11 20  
 7E38 20 32 20 32 1D 11 11 11  
 7E40 20 20 32 20 32 1D 10 11  
 7E48 11 11 11 11 11 11 11 20  
 7E50 20 32 1D 10 10 10 10 10  
 7E58 1D 1D 11 11 11 11 11 11  
 7E60 11 20 20 33 20 33 1D 10  
 7E68 11 11 11 11 11 11 11 20  
 7E70 20 33 20 33 1D 11 11 11  
 7E78 11 11 20 20 33 20 33 1D  
 7E80 1D 1D 11 20 20 33 20 32  
 7E88 33 1D 1D 1D 1D 1D 1D 1D  
 7E90 11 11 11 20 20 33 20 32  
 7E98 33 1D 1D 11 11 20 20 34  
 7EA0 20 34 1D 11 11 11 11 20  
 7EA8 20 34 20 34 1D 1D 1D 1D  
 7EB0 11 11 11 11 11 11 20 20  
 7EB8 34 20 34 1D 10 10 10 10  
 7EC0 11 11 11 11 20 20 34 20  
 7EC8 34 1D 1D 1D 1D 1D 1D 1D  
 7ED0 1D 11 20 20 35 20 35 1D  
 7ED8 1D 1D 11 11 11 11 11 20  
 7EE0 20 35 20 35 1D 10 10 10  
 7EE8 1D 1D 11 20 20 35 20 35  
 7EF0 1D 11 20 20 35 20 35 1D  
 7EF8 1D 10 1D 11 11 11 11 11  
 7FF0 A9 4C 85 70 A9 29 85 71  
 7FF8 19 7F 85 72 A9 78 85 35  
 7F10 C6 35 A0 7F A9 46 20 1C  
 7F18 CA A2 00 B5 53 10 02 49  
 7F20 80 95 53 E8 E0 07 D0 F3  
 7F28 60 E6 77 D0 02 E6 78 8C  
 7F30 87 7D A0 00 B1 77 AC 87  
 7F38 7D C9 8A F0 03 4C 76 00  
 7F40 20 01 78 4C 89 C3 93 23  
 7F48 23 23 20 50 45 54 20 50  
 7F50 49 4C 4F 54 20 23 23 23  
 7F58 00 00 20 42 59 20 20 48  
 7F60 4F 48 4E 20 4F 27 48 41  
 7F68 52 45 00 00 20 41 4E 44  
 7F70 20 4A 49 4D 20 53 54 52  
 7F78 41 53 4D 41 00 00 20 4C  
 7F80 41 42 45 4C 20 4E 4F 54  
 7F88 20 46 4F 55 4E 44 3F 00  
 7F90 11 AA RA RA RA RA RA RA

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# Microcomputer Interfacing: **FORTH vs. BASIC**

by Mark Bernstein

**BASIC and FORTH versions of programs to control a digitizer interface are compared line by line. The FORTH versions are not only faster and more space-efficient, but they are also easier to understand.**

The routines, as written, require:

PET (all versions) with FORTH  
Houston Instruments 'HIPAD'  
Digitizer

However, with slight modification, the program will run on any computer with a parallel port.

FORTH, widely considered an unusual and peculiar language, is not difficult to learn. FORTH interpreters are available for all major personal computers and, since FORTH is easy to implement, these interpreters are usually inexpensive. FORTH programs run substantially faster than programs written in microcomputer BASIC, making the language especially attractive for system programming and language implementation.

Critics object that FORTH programs are difficult to understand or modify. It has been called a write-only language, unsuitable for significant programming tasks.

If FORTH programs were especially difficult to read, FORTH's usefulness in most applications would be questionable. Careful and considerate programming, however, can produce FORTH programs that are *more* legible than their BASIC/assembly language equivalents. Indeed, many FORTH programs are easier to debug and modify than their BASIC kindred.

To demonstrate a typical FORTH application, we will discuss an interface between a Commodore PET computer and a Houston Instruments HI-PAD digitizer (figure 1). (Editor's Note: PET and AIM interfaces to Summa-

graphics' *BIT PAD* and *BIT PAD ONE* were discussed in the July, 1981 issue of *MICRO*.) This popular and inexpensive device allows an operator to transfer information from pictures, drawings, charts, or photographs to a small computer. To use the digitizer, the operator simply places the digitizer's pointer at any point of the pad's 11" x 11" active area. A built-in 8748 microcomputer measures the pointer's position, converts it into either inches or millimeters, and transmits the pointer's coordinates to the master computer.

Scientists and engineers use the digitizer to translate charts and spectra into computer-readable form. Designers and planners can use digitizers to make and revise graphics, plans, and diagrams. Since digitizers are durable and easy to understand, they are popular in schools. Digitizers may be especially important to handicapped people, making computers accessible to those who cannot conveniently use a keyboard.

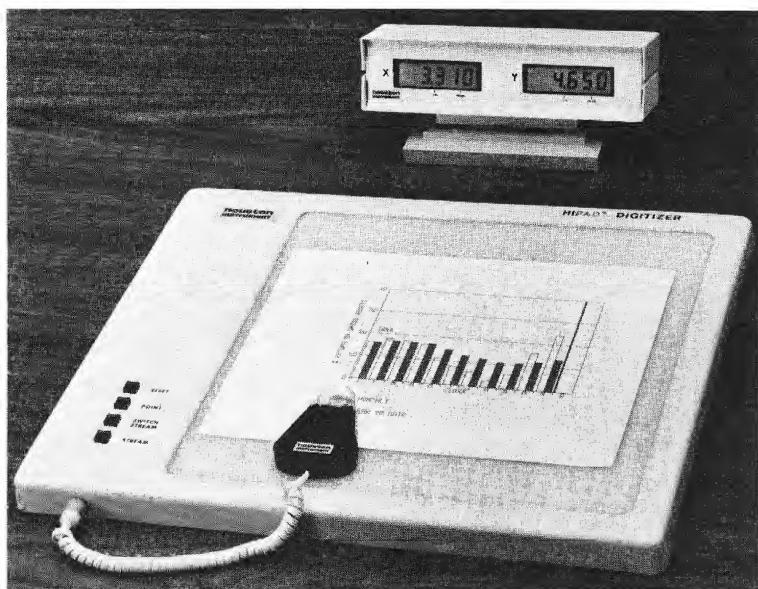
Details of the PET-HIPAD interface are covered under "The Digitizer Interface" on page 84.

## Initializing the Input Port

The computer's first task is the proper initialization of the PET's user port. The VIA is a complicated device; we won't attempt to explain all its functions and capabilities here. To properly initialize the VIA for *this* task, we must perform the following steps:

1. Define Port A as an input port by storing the value 00 in the *data direction register*.
2. Set CB2 (ACK) low by storing the binary value 110 in bits five to seven of the *control register*.
3. Request that the port observe the digitizer's STROBE signal, and report low-to-high transitions. To request this function, we set bit zero of the *control register* to one.

(Continued on page 79)



### The Digitizer Interface

Houston Instruments designed the HIPAD to be compatible with several different types of interfaces. "Parallel binary with handshaking" is the fastest option available, and allows us to connect the digitizer directly to the PET's parallel user port *via* the cable specified in figure A. Any other computer with a VIA could be used.

Each time the digitizer makes a measurement, it sends a coordinate pair (X, Y) to the computer using the protocol shown in figure B. The two coordinates are transmitted in five individual bytes. The first byte declares the start of a transmission and identifies the pad's present operating mode. Bytes two and three contain the measured X coordinate and bytes four and five contain the measured Y coordinate.

The computer can identify the initial control byte (byte one) since only this first byte has its most significant bit set to 1. If the computer tries to start listening to the digitizer in the middle of a transmission, an unexpected control byte will warn it of its mistake.

Two handshake control signals regulate the transfer of each byte from the digitizer to the computer (figure C). When the digitizer wants to send a byte to the computer, it transmits a pulse over the (normally low) STROBE line. The computer responds in turn by sending a pulse over the (normally low) ACK (ACKNOWLEDGE) line.

The digitizer transmits a STROBE pulse to tell the computer that new data are ready and waiting at the input port. The computer responds by sending an ACK pulse, which tells the digitizer the computer has read the data sent and is ready for more.

The PET's user port, a 6522 Versatile Interface Adapter (VIA) is programmed by storing numbers into its sixteen control registers (table 1). The digitizer's STROBE signal is connected to the PET's CA1 input, which we program to set a flag bit in the port's *interrupt flag register* whenever it observes an *active transition* from low-to-high. The digitizer's eight data lines are connected to the VIA's Port A, and may be read by examining the contents of the port's *data register*. Finally, the PET's CB2 output generates the ACK pulse to acknowledge a successful data transfer.

The digitizer's timing specifications require that the ACK signal's duration be between 20 and 50 microseconds. We generate this signal by using the VIA's shift register. To send an ACK pulse, we store the binary value 1000 0000 into the shift register. The shift register's timer is then set to shift a new bit out on CB2 every 40 microseconds. The shift register begins with the left-most (most significant) bit, so it sends a 1 pulse on CB2. 40 microseconds later, it sends the next bit, a 0 pulse. After another 40 microseconds, the computer sends the next bit, also a 0. The process continues until all eight bits have been sent, at which point the operation stops. The entire operation thus sends a single 40-microsecond pulse on the CB2 (ACK) line (figure D).

Since the VIA shift register operates autonomously, the PET is free to perform other computations while the ACK pulse is sent. The length of the ACK pulse, moreover, is not in any way affected by the language used to implement the interface, but is determined only by the value stored in the VIA timer register.

Figure A: PET to HIPAD Interface

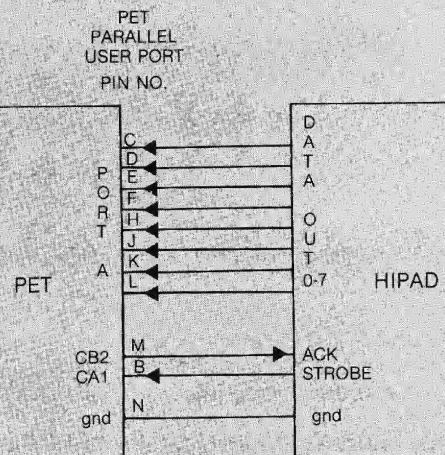


Figure B: Transmission Sequence

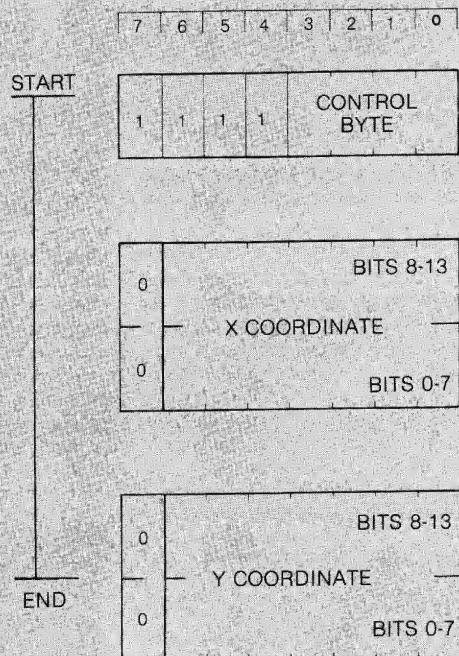
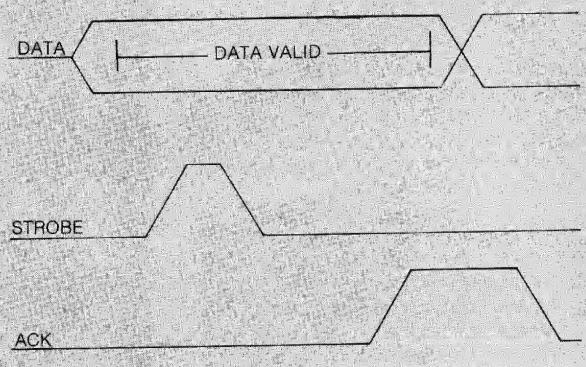


Figure C: Control Signal Timing



**Table 1: The PET computer's user I/O port is controlled by storing values into sixteen memory locations, called registers, located inside the VIA chip. The eight registers used by the digitizer interface are described above.**

Address	Name	Purpose
E841	data register	Data from the digitizer appear here.
E843	data direction register	Specifies whether each bit of the data register is to be an input or an output bit. Each bit is configured as an input (set to zero).
E84A	shift register	Data to be transmitted serially over the CB2 (ACK) output are stored here.
E848	timer #2 low-order	The rate at which the shift register operates is specified here.
E849	timer #2 high-order	This byte specifies the high-order 8 bits for the shift register rate (zero here). Writing to this register starts the shift register.
E84B	auxiliary control	Setting bit 0 of this register enables inputs to the data register
E84C	control register	Various bits in this register specify the behavior of the port's control inputs and outputs. For the digitizer interface, we must configure CA1 (STROBE) and CB2 (ACK).
E84D	interrupt flag register	When the digitizer transmits a STROBE pulse, the port automatically sets bit 1 of this register to 1. Reading data from the data register clears this bit to 0. Hence, bit 1 indicates whether new data from the digitizer are ready to be read.

(Continued from page 77)

4. Activate the input port by writing a one to bit zero of the *auxiliary control register*.

Simple subprograms in FORTH and BASIC that perform these tasks are given in listing 1. In BASIC, we define the constant VI for the base address of the VIA, and must be careful that this value is *never changed*. In FORTH, we can define fixed and unchangeable CONSTANTS, which cannot be changed at some other point in the program. FORTH, moreover, can handle names of up to 31 characters, helping to clarify the program. CTRL-REG is clearly more suggestive than VI+12, just as the FORTH command VIA-SET is cleaner than the BASIC equivalent

GOSUB 1000 : REM INITIALIZE VIA

Notice, too, that FORTH moves easily between different numerical bases. By allowing programmers to express themselves in binary, hex, or octal when appropriate, FORTH makes programs easier to decipher and debug.

*high-order byte.* This last step automatically begins the transmission sequence; no further intervention is required.

Routines to create the ACK pulse are shown in listing 2. Once more, the FORTH program is at least as clear as the BASIC code. In FORTH, we define several new constants for various VIA addresses, including SHIFT-REG, TIMER-LO, and TIMER-HI. We also define the variable ACK-TIME, which specifies the duration of the ACK pulse. Clearly, "ACK-TIME" is better than AT — its BASIC equivalent — just as SHIFT-REG is better than either SR or VI+8. ACK! is more suggestive than

GOSUB 1500: REM SEND ACK PULSE

## The STROBE Signal

The digitizer transmits a STROBE pulse to indicate that data are available and ready to be read. The STROBE signal is connected to the PET's CA1 input which, in turn, controls a flag bit in the VIA *interrupt flag* register. If the computer is waiting for data from the digitizer, it simply needs to wait for the appropriate interrupt flag. When the flag is set, and only then, the computer may read a data byte from the *data register*.

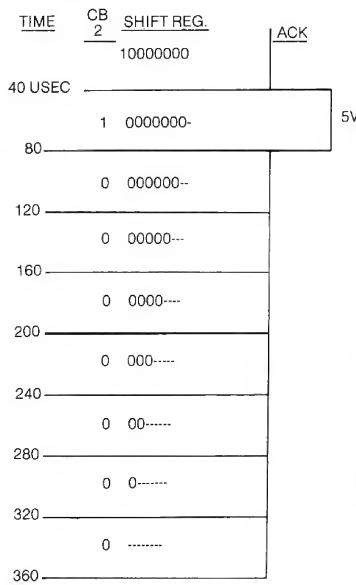
FORTH and BASIC routines that wait for the STROBE signal are given in listing 3. The two languages handle this task in similar ways, producing

## Sending the ACK Signal

Next we turn to the task of generating the ACK signal. As discussed above, we use the VIA's shift register to produce a 40-microsecond pulse. To generate this pulse, we must perform the following steps:

1. Enable the shift register. Set it to transfer one bit every time the VIA's Timer #2 reaches zero, by setting bits two and four of the VIA *auxiliary control register*. Recall that bit zero was set to one by the VIA initialization routine; the auxiliary control register should now contain the binary value of 0001 0101.
2. Store the binary value 1000 0000 into the *shift register*.
3. Set Timer #2 to shift one bit onto the CB2 output every 40 microseconds by storing a decimal 20 (one-half the number of microseconds) into the Timer #2 *low-order byte*, and then storing a zero into the Timer #2

**Figure D: Timing of the ACK Pulse**



similar programs. The FORTH program's structure is clearer, since its BEGIN...UNTIL structure eliminates the need for an undesirable GOTO. However, the BASIC program specifies more clearly the conditions for terminating the process.

### Reading Bytes

Next we combine these routines to read data bytes from the digitizer. To read any byte, the computer must first await the digitizer's STROBE pulse. It then reads a byte from the data register and acknowledges receipt by sending out an ACK pulse.

Listing 4 shows BASIC and FORTH routines to read bytes from the digitizer. The first routine reads a single byte from the digitizer. The second routine hunts for the start of a digitizer transmission, reading (and discarding) data until it finds a control byte. The third routine uses these two subroutines to read an entire transmission, including one control byte and four data bytes.

Note that the FORTH versions are substantially more concise. SYNC's BEGIN...UNTIL loop is quite clear; SYNC explicitly waits *until* it finds a control byte. PAD@, which reads an entire five-byte transmission from the HIPAD, uses FORTH's DO...LOOP structure, equivalent to BASIC's FOR ...NEXT loop:

<b>BASIC</b>	<b>FORTH</b>
FOR I=1 TO 4	5 1 DO
...	...
NEXT I	LOOP

### The Digitizer Device Driver

In listing 5, we finally come to the routine that connects the user's programs with the digitizer interface. Calling this subroutine reads one point from the digitizer, storing the coordinates in the variables X% and Y%.

Here, for the first time, BASIC is clearer than FORTH. Only in this routine does FORTH's Reverse Polish notation cause any real obscurity; fortunately, the problem is not very serious. The FORTH phrase

```
HEX
80 * +
```

is simply equivalent to the BASIC

```
( )*128 + ( )
```

#### Listing 1: Initializing the VIA input port.

<b>FORTH</b>	<b>BASIC</b>
HEX ( VIA ADDRESSES)	1000 REM === VIA INITIALIZATION
E843 CONSTANT DIR-REG	1010 VI=59456 :REM VIA BASE ADDRESS
E84C CONSTANT CONTROL-REG	
E841 CONSTANT DATA-REG	
E84B CONSTANT AUX-REG	
 ( INITIALIZE VIA )	
BINARY	
: VIA-SET	
00000000 DIR-REG C1	1020 POKE VI+3,0 : REM DATA DIRECTION
11001101 CTRL-REG C1 ;	1030 POKE VI+12,205 : REM CONTROL REG
00000001 AUX-REG C1 ;	1040 POKE VI+11,1 : REM AUX. REG
	RETURN

#### Listing 2: Using the VIA's shift register to transmit a 40 usec ACK pulse.

<b>FORTH</b>	<b>BASIC</b>
HEX	1500 REM == TRANSMIT ACK SIGNAL
( ADDITIONAL VIA REGISTERS)	
E84D CONSTANT IRQ-REG	
E848 CONSTANT TIMER-LO	
E849 CONSTANT TIMER-HI	
E84A CONSTANT SHIFT-REG	
DECIMAL	
20 VARIABLE ACK-TIME ( 40 USEC)	1510 AT=20 : REM 40 USEC
HEX	
: ACK!	
15 AUX-REG C1	1520 POKE VI+11, 21 : REM AUX REG.
80 SHIFT-REG C1	1530 POKE VI+10, 128 : REM SHIFT REG.
ACK-TIME C@ TIMER-LO C1	1540 POKE VI+8, AT : REM SET TIMER
0 TIMER-HI C1 ;	1550 POKE VI+9,0 : REM START PULSE

#### Listing 3: BASIC and FORTH routines to await data from the digitizer.

<b>FORTH</b>	<b>BASIC</b>
HEX	2000 REM === WAIT FOR STROBE
( STROBE SETS BIT 1 OF )	2010 REM STROBE SETS BIT 1 OF
( IRQ FLAG REGISTER )	2020 REM IRQ FLAG REGISTER
2 CONSTANT STROBE-FLAG	2030 REM
2040 SF=2	2050 REM
: AWAIT	
BEGIN	
IRQ-REG C@ STROBE-FLAG AND	2060 A1 = PEEK (VI+13) AND SF
UNTIL ;	2070 IF A1=0 THEN GOTO 2060
	2080 RETURN

#### Listing 4: Three subroutines to read data from the digitizer. The first reads a single byte of a multiple-byte transmission. The second reads bytes from the digitizer, discarding all until it finds a control byte. The third uses the other two to read a complete 5-byte transmission.

<b>FORTH</b>	<b>BASIC</b>
HEX	2500 REM ===FETCH 1 BYTE
( FETCH 1 BYTE )	2510 GOSUB 2000 : REM WAIT FOR STROBE
: CPAD@ AWAIT	2520 BY=PEEK(VI+1) : REM READ DATA
DATA-REG C@	2530 GOSUB 1500 : REM TRANSMIT ACK
ACK! ;	2540 RETURN
 ( WAIT FOR CONTROL BYTE )	
: SYNC BEGIN	3000 REM === WAIT FOR CONTROL BYTE
CPAD @	3010 GOSUB 2500 : REM READ A BYTE
80 AND UNTIL ;	3020 IF (BY AND 128)=0 THEN GOTO 3010
 ( READ 5-BYTE TRANSMISSION )	
: PAD@ SYNC	3500 REM ===READ 5-BYTE TRANSMISSION
4 0 DO	3510 GOSUB 3000 : REM GET FIRST BYTE
CPAD @	3520 FOR I=1 TO 4
LOOP ;	3530 GOSUB 2500
	3540 BY(I)=BY
	3550 NEXT I
	3560 RETURN

#### Listing 5: The master digitizer control routine. Users invoke this routine each time they want to read data from the digitizer.

<b>FORTH</b>	<b>BASIC</b>
HEX	
0 VARIABLE X	4000 REM === DIGITIZER DEVICE DRIVER
0 VARIABLE Y	4010 GOSUB 1000 : REM INITIALIZE
: POINT@	4020 GOSUB 3500 : REM GET DATA
VIA-SET	
PAD@	
SWAP 80 * + Y !	4030 Y% = BY(3)*128+BY(4)
SWAP 80 * + X ! ;	4040 X% = 128*BY(1)+BY(2)
	4050 RETURN

That is, the first (leftmost) item is multiplied by  $2^7$ , then added to the second (rightmost) item. This procedure, repeated for both coordinates, reduces the coordinates to standard 16-bit integers.

### Performance

When we compare the BASIC and FORTH routines in listings 1-5, we find the BASIC listings are not substantially easier to read or interpret. At times, it is true, the BASIC text conforms more closely to our expectations or to conventional notation, but elsewhere the FORTH text is clearer and more direct. The FORTH text is sometimes longer, since it explicitly declares constants, but these declarations substantially improve program clarity.

If all comments were removed, the BASIC program would be terribly difficult to understand. The FORTH program is fairly easy to interpret without comments. We know, for example, that VIA-SET must have something to do with setting up a VIA port, that ACK! must send or transmit something called ACK, and that AWAIT waits for something. GOSUB 1000, GOSUB 1500, and GOSUB 2000 are far less revealing!

Moreover, FORTH (unlike BASIC) does not discourage generous use of comments within the program. FORTH comments take no extra memory space, and don't require any execution time in the finished program.

The BASIC program can accept a point roughly every 150 milliseconds; the FORTH program can accept a point every ten milliseconds — the maximum speed at which the digitizer operates. The BASIC routines occupy 903 bytes; the FORTH routines occupy only 385 bytes. The FORTH routine is half the size of its BASIC equivalent, and runs almost 15 times faster!

### Using FORTH with Other Languages

This demonstration dramatically illustrates FORTH's superiority for controlling common devices. The FORTH code is not only faster and smaller, but it is probably easier to understand.

However, even this small example demonstrates FORTH's weakness; FORTH's Reverse Polish Notation can make algebraic expressions very obscure indeed. RPN can be very powerful; after all, many people prefer

Hewlett Packard calculators. Nevertheless, few people would argue that

4 5 2 1 + \* /.

is clearer or more easily understood than

PRINT  $\frac{(1+2)*5}{4}$  !

An excellent answer to this deficiency is to implement an algebraic language (such as BASIC or Pascal) in FORTH. A subset of Pascal is, in fact, already available. This compiler converts source text into FORTH-like object code, interpretable by FORTH's efficient inner interpreter. Since the language produces the same output as FORTH itself, FORTH and Pascal programs are free to call each other. Control and interface tasks can be handled in FORTH, while mathematical and algebraic problems can be handled using the more sophisticated Pascal parser.

For the coming decade or so, microcomputer users must continue to endure a shortage of computer power. Eventually, personal computers will be fast enough and have enough memory to

exceed most people's needs, but that time is not here yet. For the present, small computers need efficient programming systems and languages with legible source code that produces fast, concise programs. While this computer power shortage endures, FORTH and its derivatives offer a promising solution.

FORTH for PET is available from

AB Computers  
252 Bethlehem Pike  
Comar, PA 18915

FSS  
1903 Rio Grande  
Austin, TX 78705

Microtech  
P.O. Box 102  
Langhorne, PA 19047

For more information on FORTH, see MICRO's FORTH Feature in the February, 1982 issue.

Contact the authors at the Department of Chemistry, Harvard University, 12 Oxford St., Cambridge, MA 02138.

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F?1"15/16  
F?3.5

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B?B1  
D?01  
E 1.5546  
F 3.5

B  
C

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E 1.5546  
F 3.5

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# MICRO

## Short Subjects

### Apple Disk Drive Repair Repair — Do It Yourself?

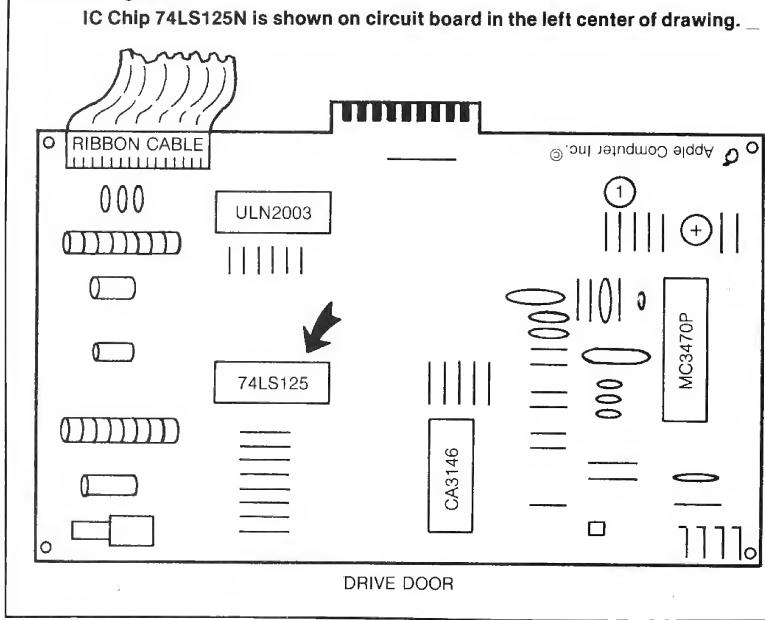
Patrick Schwab, 805 Valleywood Dr. S.E., Salem, Oregon 97306

If you've ever plugged your disk drive in wrong, take heart. Except for the noise and smoke, there is remarkably little damage. In fact, if you took your drive into your Apple dealer he would only charge you the minimum service charge. What magic does he perform to resurrect a burnt out disk drive?

Actually, only one chip, the Tri-State Buffer, has been damaged and it's easy to get at. You can remove the IC with the IC puller from your 3.3 DOS upgrade kit. The damage to that chip can be extensive. The crater caused by the melting IC is reminiscent of Mt. St. Helens. Even if you do not see any apparent evidence, you can be assured your chip has suffered damage. For \$1.50 from your Apple dealer, you can replace the 74LS125N.

#### Schwab Figure:

IC Chip 74LS125N is shown on circuit board in the left center of drawing.



### Apple Disk Drive Repair Horizontally Scrolled Messages Breakpoint Utility for OSI C1P

by Patrick Schwab

by Chris Williams

by John Seybold

#### Replacing the 74LS125N

1. Make sure the computer is off.
2. Touch the power supply to discharge any static electricity.
3. Unplug the drive from the controller card.
4. Turn the drive upside down.
5. Remove the four black screws on the bottom of the drive.
6. Turn drive rightside up.
7. Slide the drive cover back and remove it.
8. Locate IC chip #74LS125N — refer to drawing below.
9. Use IC puller to lift the chip straight up.
10. Insert the new chip with writing as in drawing.
11. Slide the cover back over the drive.
12. Check the cable to make sure it is not pinched or twisted.
13. Turn the drive upside down.
14. Replace the screws.
15. Plug the drive back on the card. Make sure you do not off-set the plug to the second row of pins; if you do, go to step 1.

### Horizontally Scrolled Messages

Chris Williams, 5676 S. Meadow La. #101, Ogden, Utah 84403

Horizontally scrolled ("ticker-tape") messages capture and hold the interest of onlookers. Any good marketing professional will tell you that getting the attention of a consumer is over half the job of selling.

Here is a program that will scroll a user-defined message across the screen at a user-defined rate. It's written in Applesoft and will run without crowding in a 16K machine. The total number of characters (including trailing periods) allowed in the message is 256 in each of the two DATA statements for a total of 512.

The two DATA statements at lines 45 and 55 are the source of the message and can be changed. Line 85 is the internal delay loop; changing its index's maximum value (currently 60) will vary the scrolling speed.

The heart of the program is in the rest of the "I" loop. Both the HTAB and MID\$ commands print out the correct number of characters from the string at a decrementing horizontal cursor location, while incrementing the character number within the string where printing begins. These three simultaneous selections result in the right-to-left horizontal scrolling effect.

You can use the program as a whole, or strip out the "I" loop if you want to add it to another program. But I suggest

you keep my convention of trailing periods at the end of each part of the message. I've found that without them you lose continuity and, worse, the watcher's interest.

### Williams Listing

```

10 REM *** ADVERTISE ***
20 REM *** BY C WILLIAMS ***
30 HOME : VTAB 10: PRINT "THIS P
PROGRAM WILL ALLOW YOU TO INF
UT AN ADVERTISEMENT AND HAVE
IT SCROLL HORIZONTALLY ACRO
SS THE SCREEN AT VARYING RAT
ES."
33 REM THIS LOOP DELAYS TO KEEP
34 REM PROGRAM DESCRIPTION ON T
HE SCREEN FOR LONG ENOUGH TO
READ
35 FOR Y = 1 TO 3000: NEXT Y: HOME
36
40 READ ADS
44 REM DATA STATEMENT CONTAINS
ADVERTISEMENT
45 DATA "HELLO! I AM AN A
PPLE COMPUTER AND I CAN DO A
WHOLE LOT MORE THAN JUST AD
VERTISE MYSELF. COME ON IN
AND ASK ABOUT ME....."
46
47 REM 70 SUBROUTINE CONTAINS S
CROLLER
48 GOSUB 70
50 READ ADS
54 REM DATA STATEMENT CONTAINS
ADVERTISEMENT
55 DATA "THE PEOPLE HER
E WILL BE DELIGHTED TO SHOW
YOU HOW I CAN HELP YOU. AND
REST ASSURED THAT I ALMOST
CERTAINLY CAN....."
56
57 REM 70 SUBROUTINE CONTAINS S
CROLLER
58 GOSUB 70
59 REM RESET READ STATEMENTS AND
D LOOP BACK
60 RESTORE : GOTO 40
65 REM SET LOOP INDEX = STRING
LENGTH
70 L = LEN (ADS)
75 II = 1
77 REM VARIABLE SET FOR SPEED
78 FT = 40:UND = 1:ZR = 0
80 FOR I = 1 TO L
84 REM J LOOP CONTROLS SCROLL SPEED,
CHANGE INDEX IF YOU WI
SH
85 FOR J = 1 TO 60: NEXT J
87 REM VTAB CENTERS SCROLLED "T
ICKER-TAPE"
90 VTAB 14
95 TNUM = FT - I: IF TNUM < ZR THEN
II = II + UND
96 IF TNUM < = ZR THEN TNUM = UND
97 REM TNUM CONTROLS HTAB WHICH
IS HEART OF SCROLLER, WHEN
< 0 MOVE STARTING POINT TO R
IGHT IN STRING
100 HTAB TNUM
105 M = I: IF I > FT THEN M = FT
110 PRINT MID$ (ADS,II,M)
115 REM LOOP BACK FOR NEXT CHAR
ACTER
120 NEXT I
124 REM DONE
125 RETURN

```

### Seybold Listing

```

1 ;BREAKPOINT UTILITY
2 ;
3 ;BY JOHN SEYBOLD
4 ;
5 WARM EQU $A274
6 ;
7 ORG $1C0
8 OBJ $800
9 ;
01C0 48 10 PHA ;SAVE ACCUMULATOR
01C1 8D 88 D3 11 STA !54152 ;PUT IT ON THE SCREEN
01C4 A9 41 12 LDA 'A' ;PRINT 'A' LABEL
01C6 8D 86 D3 13 STA !54150 ;PRINT 'X' LABEL
01C9 A9 58 14 LDA 'X' ;PRINT 'X' LABEL
01CB 8D 8D D3 15 STA !54157 ;PRINT 'Y' LABEL
01CE A9 59 16 LDA 'Y' ;PRINT 'Y' LABEL
01D0 8D 94 D3 17 STA !54164 ;PUT X ON THE SCREEN
01D3 8E 8F D3 18 STX !54159 ;PUT Y ON THE SCREEN
01D6 8C 96 D3 19 STY !54166 ;POLL KEYBOARD UNTIL A CHAR. R
01D9 20 00 FD 20 JSR $FD00 ;IS IT A 'S'?
EC'D
01DC C9 53 21 CMP 'S' ;IF NOT, THEN RETURN
01DE D0 03 22 BNE RET ;OTHERWISE WARMSTART
01E0 4C 74 A2 23 JMP WARM
01E3 68 24 RET PLA
01E4 40 25 RTI

```

### Seybold Figure

A] X + Y!

## Breakpoint Utility for OSI C1P

John S. Seybold, 2130 University Ave.  
#74, Madison, Wisconsin 53705

Recently, while debugging a user subroutine, I became aware of the value of a breakpoint utility. I was unable to read the contents of the registers and it was impossible to tell what the processor was doing. Since I could not afford an extended monitor, I wrote this short program to do the trick. The program makes use of the fact that the 6502 sees a BRK instruction as a software interrupt and jumps to the subroutine that has its address at \$FFFF and \$FFFF. In the C1P and Superboard, that address is \$1C0.

If you are familiar with the C1P's memory map, you will have noticed that this address is at the top of the BASIC stack area. If you call your machine code program from a BASIC program that uses a large amount of stack, then you will have to relocate the utility. This poses no problem since the code is entirely relocatable, but you must key in a JMP instruction at \$1C0. For example, if you want to put the utility in page two, simply key in \$4C 22 02 into locations \$1C0 through \$1C2 and then put the utility

in, starting at \$222. (Beware of overwriting your user routine if it is also in page two.)

To use the utility, just add "BRK NOP" to your program wherever desired. The NOP is to allow for the fact that the 6502 saves the contents of the program counter, plus two, when it executes a break instruction which is only one byte long. Once the breakpoints have been added and the utility is in memory, you may run your program.

When a breakpoint is encountered, you will see a display similar to the one shown in the figure. A, X, and Y stand for the respective registers. The figure next to each letter is the graphics character of the code in that register. To resume execution of your program, simply hit any key on the keyboard except "S". Hitting "S" will stop the program completely and warm start the machine to allow you to check memory locations. Once you have stopped, you must run the program from the beginning again, but when you get to the same breakpoint, you will know what is in each memory location, if you haven't made any changes.

The program is heavily commented so as to be self-explanatory. I hope that it will be as much help to you as it was to me.

**MICRO**

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# PRINT AT for OSI Systems

by Matt Asay

**By loading this routine, the AT keyword is recognized in a PRINT statement. The routine is designed for an OSI C1P but should work (with the modifications suggested) on a C4P or C8P. The method used here could probably be adapted to add recognition of new statements or keywords to other Microsoft BASICs such as the PET. A useful hex object code loader is also provided.**

## PRINT AT

requires:

OSI C1P

May be modified easily for C2P.

The Microsoft BASIC on an Ohio Scientific C1P has most of the features found on other versions. One feature that (unfortunately) is lacking is the ability to print at a selected location on the screen. There are some ways to get around this by using POKE but you are limited to POKEing one character at a time. It is slow and cumbersome to do.

I have developed a program to remove these limitations by adding an AT option to the PRINT statement. Once this program is installed you can print anything anywhere on the screen with ease. The program hides itself at the top of your available memory on any size system, using only 166 bytes of permanent storage. After it has been entered you can write, save, load, and run programs using the new PRINT AT statement. Programs which do not use AT in their PRINT's should function the same as always.

The three forms of the statement are:

PRINT AT *location*; *print-list*;

where *location* is:

## BASIC Program to Load and Initialize PRINT AT

(See text for description of the Relative Hexadecimal Loader)

```
1 REM ((PRINT AT))
2 REM BY MATT ASAY
3 REM ((REL HEX LOADER))
5 QSUB 10: GOTO 1000
10 DEF FNH(DX)=ASC(MID$(H$,DX,1))
20 DEF FNHD(DX)=FNA(DX)-48+(FNA(DX)>64)*7
30 DEF FNBD(DX)=FNHD(DX)*16+FNHD(DX+1)
40 DEF FNHR(DX)=((FNHD(DX)*16+FNHD(DX+1))*16+FNHD(DX+2))*16+FNHD(DX+3)
45 READ H$: R0=PEEK(134)*256+PEEK(133)-FNH(1)
50 READ: H$: R0=RO TO 32767: READ H$: ON LEN(H$) GOTO 51,52,53,54,55: GOTO 54
51 RETURN
52 POKE HA,FNB(1): NEXT: STOP
53 RA=R0+FNH(2): GOTO 56
54 POKE HA,FNB(1): FOR I=3 TO LEN(H$) STEP 2: HA=HA+1: POKE HA,FNB(I):
NEXT I: NEXT: STOP
55 RA=R0+FNH(2)
56 IF LEFT$(H$,1)="H" THEN POKE HA,RA/256: NEXT: STOP
57 POKE HA,RA AND 255: IF LEFT$(H$,1)="R" THEN HA=HA+1: POKE HA,RA/256
58 NEXT: STOP
```

Size of code in hex

```
100 DATA 00FD
Code for USRX
110 DATA R9,L57,R0,H57,658184828583848485858486R207
120 DATA BD,R4F,95C5CA10F8AD1A02AC1B02BD,RE6,8C,RE7
130 DATA A9,LE1,RO,HE1,8D1A028C1B02AD1C02RC1D02
140 DATA 8D,RFB,8C,RFC,A9,LF6,RO,HF6,8D1C028C1D02A988R0RE
150 DATA 850B840C6C920F034C,R57,OO
```

Code for PSPLIC

```
160 DATA 24CC1014C941D00E489848R001B1C3C934F013
170 DATA 68A86806CCC997D002B85CCC93B0034CCD0060
```

Code for PR.AT

```
180 DATA 46CCE8A86820BC0020C000C9A5D00620BC0038
190 DATA B04120C1RA2008B420C200C92CD023A110R0R
200 DATA 0R0R26120A8511A5122R485114820C9RA2008B4
210 DATA 6818651185116865128512A5118D,RE9,A5122903
220 DATA 0SD08D,RE9,20C200C93BD0034CB00H91C85CC4C4ER2
```

Code for DSPLIC

```
230 DATA 24CC70034C00008D00DOEE,RE9,D003EE,RE9,C60E60
```

Code for CSPPLIC

```
240 DATA A90085CC4C0000
```

End of load data marker

```
250 DATA *
```

This code initializes PRINT AT while preserving any previous USR function  
1000 UL=PEEK(11)
1010 UH=PEEK(12)

```
1020 POKE 11,RO-INT(R0/256)*256
1030 POKE 12,R0/256
1040 X=USR(X)
1050 POKE 11,UL
1060 POKE 12,UH
```

The following code is a short demonstration of the use of PRINT AT

```
1200 PRINT: PRINT
1210 PRINT "TEST PROGRAM"
1220 FOR I=1 TO 20: PRINT: NEXT
1230 PRINT AT 10*32+5;"PRINT";
1240 PRINT AT *;"AT";
1250 PRINT AT 12,5;"HAS BEEN";
1260 PRINT "WORKS !!!";
1270 PRINT AT *;"LOADED...";
1280 R$="AND IT"
1290 PRINT AT 14,20-LEN(R$);R$;
1300 FOR I=1 TO 500: NEXT
```

1. A numeric expression. Printing starts at `sc + INT(expression)`, where `sc` is the address of the screen.
2. Two numeric expressions separated by a comma. Printing starts at `sc + INT(expr1)*32 + INT(expr2)`. This allows specification of location by row and column.
3. An asterisk (''\*'). Printing continues with the position immediately after the last character printed by the last `PRINT AT`.

*print-list* is any allowable list of items to be printed, separated, by semicolons. The trailing semicolon is necessary since the carriage return and linefeed that BASIC tags on will print as their corresponding graphics characters. This was done intentionally to allow the printing of all graphics characters using CHR\$( ).

## Examples

```
PRINT AT 200;CHR$(248);“ < - A tank”;
```

PRINT AT X,Y; "PRINT AT ROW X,  
COLUMN Y";

PRINT AT 15,7; "PRINT AND ";

A\$ = "ADD"

PRINT AT \*; A\$ + " MORE";

PRINT "PRINT ON BOTTOM AND  
SCROLL"

## How to Install

Once I had developed this program I needed an easy way to install it on a system. I considered and rejected making a tape that the monitor could read. It would be difficult to modify, error-prone on input, and would work only if loading to a fixed absolute address. I did not want to use a BASIC program that POKEd in several DATA statements of decimal values since I think in hex when programming in assembly. For this reason I created a BASIC program that reads hex strings and converts them to binary and loads them into memory. To make it adaptable it calculates a starting load address from the size of the program and the address of the top of memory.

Enter the program shown on listing 1, save it to tape and then run it. After it is through loading (about 15 seconds) it will print "PRINT AT HAS BEEN LOADED... AND IT WORKS !!!"

### Assembly Listing of PRINT AT Routine

Assembly listing of PRINT AT routines  
(Underlined values entered as relative addresses in DATA statements)

### Assembly Listing (continued)

```

2190  B0 41      BCS  PR, R3      BRANCH ALWAYS
2192  20 C1 AA  PR, R0  JSR  $A0C1  COLLECT EXPRESSION 1
2195  20 08 B4      JSR  $B40B  CONVERT TO INTEGER
2198  20 C2 00      JSR  $00C2  FOLLOWED BY ",", "?"
219B  C9 2C      CMP  #','
219D  D0 23      BNE  PR, R2  BRANCH NO
219F  R5 11      LDA  $11  PUSH INT(EXPR1)*32 ONTO STACK
21A1  OR      ASL  A
21A2  OR      ASL  A
21A3  OR      ASL  A
21A4  OR      ASL  A
21A5  26 12      ROL  $12
21A7  OR      ASL  A
21A8  R5 11      STA  $11
21A9  R5 12      LDA  $12
21AC  2R      ROL  A
21AD  48      PHA
21AE  R5 11      LDA  $11
21B0  48      PHA
21B1  20 C9 RA  JSR  $A0C9  COLLECT 2ND EXPRESSION
21B4  20 08 B4  JSR  $B40B  CONVERT TO INTEGER
21B7  68      PLA  ADD INT(EXPR1)*32
21B8  18      CLC
21B9  65 11      ADC  $11
21B8  65 11      STA  $11
21BD  68      PLA
21BE  65 12      ADC  $12
21C0  65 12      STA  $12
21C2  R5 11  PR, R2  LDA  $11  ADD $D000, STORE AS "AT" ADDRESS
21C4  BD E9 21  STA  ATLO
21C7  R5 12      LDA  $12
21C9  29 03      AND  ##03
21CB  09 00      ORA  ##00
21CD  BD E9 21  STA  ATHI
21D0  20 C2 00  JSR  $00C2  GET NEXT CHARACTER
21D3  C9 3B  PR, R3  CMP  '#';'  MUST BE ":"'
21D5  D0 03      BNE  $00B00  BRANCH IF NOT
21D7  4C BC 00  JMP  $00BC  GET NEXT CHAR AND RETURN TO
;                                PRINT ROUTINE
21DA  R9 1C      B00B00  LDA  #28  LOAD OFFSET OF "ST" ERR MSG
21DC  85 CC      STA  ATFLG  RESET PRINT AND AT FLAGS
21CE  4C 4E R2  JMP  $A24E  PRINT ERROR MESSAGE
;                                ;
0097  PRTOK  =  $97  BASIC TOKEN FOR "PRINT"
00A5  ASTOK  =  $A5  BASIC TOKEN FOR "*"
;                                ;
OSPLIC  =  *  OUTPUT VECTOR SPLICE
21E1  24 CC      BIT  ATFLG  "AT FLAG" SET ?
21E3  70 03      BVS  OS, 1  BRANCH IF YES
21E5  4C 00 00  OS, 0  JMP  **-  DO NORMAL OUTPUT AND RETURN
21E8  BD 00 00  OS, 1  STA  $D000  STORE CHARACTER ON SCREEN
21E9  AT, LO  =  **-  LOCATION TO STORE IN (LOW BYTE)
21EA  AT, HI  =  **-  (HIGH BYTE)
21EB  EE E9 21  INC  AT, LO  INCREMENT SCREEN ADDRESS
21EE  D0 03      BNE  OS, 2
21FO  EE E9 21  INC  AT, HI
21F3  C6 0E      OS, 2  DEC  $0E
21F5  60      RTS  DON'T LET CHAR COUNT OVERFLOW
;                                ;
21F6  CSPLIC  =  *  CONTROL-C VECTOR SPLICE
21F6  R9 00      LDA  #0  END OF STATEMENT,
21F8  85 CC      STA  ATFLG  SO RESET PRINT, AT FLAGS
21FA  4C 00 00  CS, 0  JMP  **-  DO NORMAL CONTROL-C STUFF
21FD  END

```

Addresses and Subroutines used in PRINT AT

\$000B Address of USR subroutine vector

\$000E Current "characters printed" count. Incremented by BASIC before output routine is called.

\$0011 Integer part (low,high form) of number in floating point accumulator (\$00C0-\$00AF) after a call to "fix" routine at \$B40B.

\$0081 Address of start of string storage Set to start of PSPLIC by USR

\$0083 Address of string scratchpad call (initialization) to protect

\$0085 Address of end of memory+1 PRINT AT routine.

\$00BC Increment current character pointer and fetch next character of BASIC program. Return with Z set if end of line or ":"; C clear if "0"-"9", blanks skipped over.

\$00C2 Fetch current character, setting status as above.

\$00C3 Address of current character.

\$021A Address of print routine.

\$021C Address of routine to check for control-C. (Called at the end of each BASIC statement).

\$A24E BASIC error message routine. Use A as offset into error message table.

\$A0C1 Collect expression starting at current character of program. Put result into floating point accumulator (\$A0C-\$AF).

\$A0C9 Collect expression starting with next character of program.

\$AEB8 Default address for USR routine. Prints "FC" error message.

\$B40B Converts number in floating accumulator to integer and stores it at \$11,\$12 (low,high form).

\$D000 Address of start (upper left corner) of screen.

across several lines of the screen. Then you may type NEW and enter or LOAD any program you like, using PRINT AT.

If an error occurs in the middle of a PRINT AT statement the "AT flag" can be turned off by typing any valid BASIC statement (i.e., LIST or "?" for PRINT, etc.) at the keyboard.

### Relative Hexadecimal Loader

The loader reads strings from data statements and loads a program into high memory. The program consists of four parts:

#### 1. Program size:

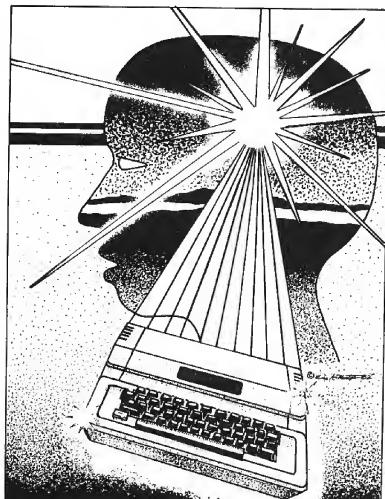
A 4-digit hex number. This value is subtracted from the end-of-memory address at \$0085 to get the starting address for the program.

#### 2. Non-relocatable hex data:

A string of any number of bytes in hex form.

#### 3. Relocatable addresses:

A prefix character R, H, or L followed by two or four hex characters. The hex number is added to the starting



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address of the program. The resulting address is stored as follows:

R: Store both bytes (low, high form).  
H: Store high byte.  
L: Store low byte.

4. End of program marker:

Any single character ("\*" is used here).

You can use the loader program for your own machine language routines. Use lines 1-58 as shown. Replace 100-999 with DATA statements for your code in the format shown. When the program has finished loading it will jump to 1000 with R0 set to the starting load address. Your statements here should protect your program if desired and perform any other initialization needed.

### How the Program Works

The program has four parts: a USR call for initialization, "splices" into the BASIC parse, output, and control-C routines.

The USR routine changes the top of memory address to protect the permanent part of the program (not including

this initialization). It patches the other three pieces into their respective vectors. The code at line 1000 saves and restores the previous USR address, so this routine can be loaded after another USR routine without messing it up.

The second piece is spliced into the parse routine at \$BC-\$D3. This routine fetches the program for the BASIC interpreter a character/token at a time. When not in a PRINT statement this routine works normally. Otherwise it checks for an AT following the PRINT token. If it is found, the routine collects and interprets the location specification. It then returns the character following the first semicolon to the print routine as if the "AT location;" had not been there.

The third piece is spliced into the output vector. Any time the "AT flag" (bit 1 of \$CC) is on, instead of going to the normal print routine, it outputs to the current screen location and then increments the location. It then decrements the character count (which the routine that calls it increments) to prevent overflow and returns to the caller.

The last piece is spliced into the control-C vector. This vector is called

at the end of each statement (to check if control-C is depressed). The spliced routine unconditionally resets the "AT flag" before going to the normal control-C routine. This prevents an error, control-C, or END of the program from leaving the "PRINT AT" on when control returns to the user.

This program takes 253 bytes to load, but after initialization requires only 166 bytes. If you wish to preserve the initialization code also just change the "L57" in line 110 to "L00".

The only change which should be necessary to use this routine on a C2P is to change the code at 219F-21B0 to multiply by 64 instead of 32.

---

Matt Asay is a senior analyst at Queue Systems Incorporated where he develops process control and data acquisition systems. He holds a degree in Computer Science from CSU, Sacramento. His home computer is an OSI C1P with 20K RAM and a floppy disk. He may be contacted at 2925 Janet Drive, West Sacramento, CA 95691.

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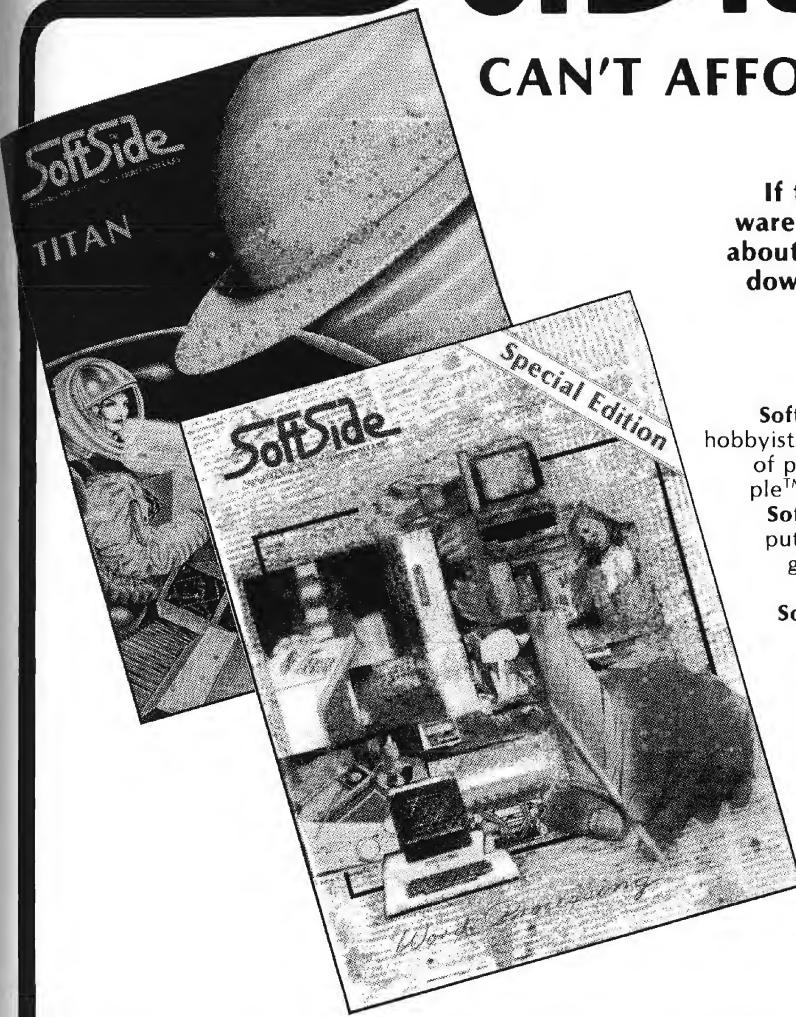


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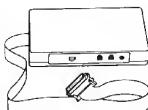
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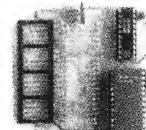
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# Symbol Table Lister for the OSI

by Rolf Johannssen

**Use this routine to list the symbol table generated by the OSI C1P Assembler.**

## Symbol Table Lister

## OSI C1P OSI C1P Assembler

## Introduction

Programming in assembly rather than a high level language (BASIC, Pascal) may be preferred for one of three main reasons: speed, economy of memory usage, and the ability to do things not available in the higher level languages. Small sections of code can be assembled by hand and entered using a simple monitor. However, this is a tedious process and prone to error. For any serious assembly language coding an assembler program must be used. An assembler will read source code, check for errors, generate all necessary cross-references, and produce the desired assembled code. A listing may optionally be produced by the assembler.

## The OSI C1P Assembler-Editor

The OSI C1P assembler does all of these things and has editing capability as well so that the user can conveniently enter source code from keyboard or tape and edit it before assembly. One desirable option lacking in the OSI assembler is the ability to list or print out a *symbol table* following the listing. This is a table listing all symbols and labels together with their assigned values. A symbol table is a valuable adjunct in reading a program listing. When modifying a program, it helps you avoid inadvertent duplication of symbols or labels. A complete cross-reference program would be even more useful, and would not be difficult to write. For my own use, the extra effort and extra memory required did not

## Symbol Table Lister

```

;      SYMBOL TABLE LISTING PROGRAM
;      LAST REVISION 14 JAN 82
;      PAGE ZERO LOCATIONS
LL  = $0A          LAST LINE USED IN SYMBOL TABLE
BC  = $10          BYTE COUNTER
CC  = BC+1         CHAR. COUNTER
CSV = CC+1         SAVED CHARACTER
MCTR= CSV+1        MULT. CHAR. COUNTER
XP  = MCTR+1       X POINTER
XSV = XP+1         X REG. SAVE
YSV = XSV+1        Y REG. SAVE
LN  = YSV+1        LINE NUMBER
LW  = LN+2         LAST WORD
PTR = LW+2         POINTER
PTR2= PTR+2        SECOND POINTER
BFR = PTR+2        BUFFER
DEST= BFR+8        DESTINATION BUFFER
M   = DEST+8       MINIMUM SYMBOL VALUE
MP  = M+4          MINIMUM IN CURRENT LOOP
CTR0= $64          CTRL/D FLAG AS IN BASIC
;      ADDRESS EQUATES
BCB = $0100        BASIC ASCII BUFFER
PFL = $0205        SAVE-TO-TAPE FLAG
STMEM=$12C9        START OF MEM FOR SOURCE
STS = $12CB        TOP OF STORAGE
NL  = $12FE        NEXT LOCN FOR SOURCE
CRL = $A86C        BASIC RETURN-LINE FEED
BFF = $B7E8        BASIC HEX-DEC CONVERSION
BPF = $B9E6        BASIC DEC-ASCII CONVER
EXM = $E800        EXTENDED MONITOR
PHEX= $EAAC        PRINT HEX CHAR.
DVD = $EE6C        16-BIT DIVIDE ROUTINE
PRINT=$FFFF        PRINT VECTOR
;      PROGRAM STARTS HERE
350 1391          *=+$1391
360 1391          A900
370 1393          852F
380 1395          8530
390 1397          8531
400 1399          8532
410 139B          8564
420 139D          38
430 139E          A50A
440 13A0          E904
450 13A2          8519
460 13A4          A50B
470 13A6          E900
480 13A8          851A
490 13AA          206EB9
500 13AD          206CAB
510 13B0          A9FF
520 13B2          8534
530 13B4          ACCB12
540 13B7          ADCC12
550 13BA          851C
560 13BC          A900
570 13BE          851B
370 1391          STA M          INITIALIZE MINIMUM
370 1393          STA M+1        TO ZERO
370 1395          STA M2
370 1397          STA M3
370 139B          STA CTR0        ALLOW PRINTING
370 139D          SEC
370 139E          LDA LL          SET POINTER LW TO LAST
370 13A0          SBC #4
370 13A2          STA LW
370 13A4          LDA LL+1        LOCN IN SYMBOL TABLE
370 13A6          SBC #0
370 13A8          STA LW+1
370 13AA          JSR BPF
370 13AD          JSR CRL
510 13B0          LOOP1 LDA #$FF
520 13B2          STA MP+1
530 13B4          LOOP2 LDY STS
540 13B7          LDA STS+1
550 13BA          STA PTR+1
560 13BC          LDA #0
570 13BE          STA PTR
370 1391          MAKE MP > ANY POSSIBLE
370 1393          SYMBOL
370 1395          SET PTR+Y TO TOP
370 1397          OF SYMBOL TABLE
370 139B          DECREMENT Y AS TABLE
370 139D          IS READ

```

(Continued)

seem to be worthwhile. This article presents a symbol table lister for the OSI C1P (cassette version).

### Operation of the Assembler-Editor

In the OSI assembler, source code is stored in memory as it is read in, beginning at the location following the end of the assembler. Numbered lines are inserted at their correct position. Each line begins with two bytes containing the line number in hex, in the order low, high. The line ends with a return (\$0D). Line feeds are not stored in the source text but are added during printing after each return. There is no special signal to indicate end-of-text as in BASIC; rather the editor keeps the next location available for text in a table (see below.) When an assembly is requested, a symbol table is built which begins at the last location in RAM and moves to successively lower addresses as more symbols are added. Each symbol requires six locations for storage: four bytes for the symbol itself (encoded) and two bytes for the value of the symbol. A symbol may be from one to six characters in length. It must begin with an alphabetic and the remaining characters must be in the set A-Z, 0-9, :, ., or \$. The symbol table is not sorted, nor is a hash table used; the symbols are simply entered in the order in which they are encountered. A forward reference causes an entry to be made in the symbol table with a value which appears to be random. When the symbol is subsequently defined, its value is adjusted at that time.

### Operation of the Symbol Table Lister

The assembler maintains pointers to the start and end of source code and the start and end of the symbol table. These are shown as STMEM, NL, STS, and LL in the accompanying listing. Let me define "equivalence" as the numerical representation in which the symbol is stored, "value" as the value assigned to the symbol. E.g., "LABEL" always has the equivalence \$4B2A2120; its value may be anything from \$0000 to \$FFFF.

The lyster program begins by zeroing a 4-byte memory location, M. It then scans the symbol table to find the smallest equivalence greater than or equal to M (the smallest symbol numerically is also the earliest alphabetically.) The value of the found minimum equivalence is incremented by one and stored in M before the table is searched again. Thus the table is

#### Symbol Table Lister (continued)

580 13C0 C010	LOOP3 CPY #\\$10	WHEN Y GETS BELOW \\$10
590 13C2 B00E	BCS TRN	ADD \\$80 AND DECREMENT
600 13C4 98	TYA	PTR BY \\$80 TO AVOID
610 13C5 0980	ORA #\\$80	ADDRESSING ERRORS IF
620 13C7 A8	TAY	Y DECREMENTS FROM
630 13C8 A51B	LDA PTR	00 TO FF
640 13CA 4980	EOR #\\$80	
650 13CC 851B	STA PTR	
660 13CE 1002	BPL TRN	
670 13D0 C41C	DEC PTR+1	
680 13D2 98	TRN TYA	COMPARE PTR+Y TO LW
690 13D3 38	SEC	TO SEE IF SEARCH ENDED
700 13D4 E903	SBC #3	
710 13D6 A8	TAY	
720 13D7 18	CLC	
730 13D8 651B	ADC PTR	
740 13D9 08	PHP	
750 13DB C519	CMP LW	
760 13DD D018	BNE CONT	
770 13DF 28	PLP	
780 13E0 A51C	LDA PTR+1	
790 13E2 6900	ADC #0	
800 13E4 C51A	CMP LW+1	
810 13E6 D00E	BNE CM1	IF MP+1=\\$FF THEN
820 13E8 A534	LDA MP+1	SYMBOL TABLE EXHAUSTED
830 13E9 C9FF	CMP #\\$FF	SO QUIT BUT IF
840 13EC D048	BNE PRNT	MP+1<\\$FF THEN A SYMBOL
850 13EE A900	LDA #0	HAS BEEN FOUND PRINT IT
860 13F0 800502	STA PFL	TURN OFF SAVE FLAG
870 13F3 4C00E8	JMP EXM	
880 13F6 08	CM1 PHP	
890 13F7 28	CONT PLP	DOUBLE LOOP FOR 32-BIT
900 13FB A200	LDX #0	SUBTRACT
910 13FA 38	CLDOP SEC	WHEN X=0, COMPARE
920 13FB B11B	LDA (PTR),Y	CURRENT VALUE IN SYMBOL
930 13FD F531	SBC M+2,X	TABLE WITH M IF VALUE
940 13FF C8	INY	IS M THEN OMIT 2d LOOP
950 1400 B11B	LDA (PTR),Y	IF VALUE=>M THEN
960 1402 F532	SBC M+3,X	COMPARE CURRENT VALUE
970 1404 88	DEY	WITH MINIMUM (THIS LOOP)
980 1405 88	DEY	IN MP IF VALUE=>MP THEN
990 1406 88	DEY	CONTINUE SEARCH BUT
1000 1407 B11B	LDA (PTR),Y	IF VALUE<MP THEN
1010 1409 F52F	SBC M,X	REPLACE MP BY
1020 140B C8	INY	NEW MINIMUM
1030 140C B11B	LDA (PTR),Y	
1040 140E F530	SBC M+1,X	
1050 1410 08	PHP	
1060 1411 E000	CPX #0	
1070 1413 D008	BNE TMP	
1080 1415 28	PLP	
1090 1416 9019	BCC NXWORD	
1100 1418 C8	INY	
1110 1419 A204	LDX #4	
1120 141B D0DD	BNE CLDOP	
1130 141D 28	TMP PLP	
1140 141E B011	BCS NXWORD	
1150 1420 A200	LDX #0	
1160 1422 88	DEY	
1170 1423 B11B	MUMP LDA (PTR),Y	COPY SYMBOL (CODED) AND
1180 1425 9533	STA MP,X	ITS VALUE FROM PTR+Y
1190 1427 C8	INY	INTO MP
1200 1428 E8	INX	
1210 1429 E006	CPX #6	
1220 142B D0F6	BNE MUMP	
1230 142D 98	TYA	
1240 142E E905	SBC #5	
1250 1430 A8	TAY	
1260 1431 88	NXWORD DEY	
1270 1432 88	DEY	
1280 1433 4C0013	JMP LOOP3	
1290 1436 A208	PRNT LDX #8	FILL PRINT BUFFER
1300 1438 A920	LDA #\\$20	WITH SPACES
1310 143A 951E	STB STA BFR-1,X	
1320 143C CA	DEX	
1330 143D D0FB	BNE STB	
1340 143F B533	CPM LDA MP,X	COPY CURRENT MINIMUM TO
1350 1441 952F	STA M,X	GLOBAL MINIMUM
1360 1443 E8	INX	
1370 1444 E004	CPX #4	
1380 1446 D0F7	BNE CPM	
1390 1448 E631	INC M+2	INCREMENT GLOBAL MIN.
1400 144A D002	BNE LOOP3.	FOR NEXT PASS
1410 144C E632	INC M+3	
1420 144E A000	LOOP3. LDY #0	NOTE LOOP3. NOT= LOOP3

**Symbol Table Lister (continued)**

```

1430 1450 8414 STY XP
1440 1452 A901 LDA #1
1450 1454 8510 STA BC
1460 1456 A203 LOOP4 LDX #3
1470 1458 B93300 LOOP4P LDA MP,Y
1480 145B 85DC STA $DC
1490 145D C8 INY
1500 145E B93300 LDA MP,Y
1510 1461 85DD STA $DD
1520 1463 C8 INY
1530 1464 BDDC15 LOOPS LDA DVS,X
1540 1467 85DE STA $DE
1550 1469 CA DEX
1560 146A BDDC15 LDA DVS,X
1570 146D 85DF STA $DF
1580 146F CA DEX
1590 1470 8615 STX XSU
1600 1472 8416 STY YSU
1610 1474 A204 LDX #4
1620 1476 A900 LDA #0
1630 1478 95D7 STRZER STA $D7,X
1640 147A CA DEX
1650 147B D0FB BNE STRZER
1660 147D A210 LDX #10
1670 147F 206CEE JSR DVD
1680 1482 8A TXA
1690 1483 F04C BEQ GADR
1700 1485 C91B NXCHR CMP #$1B
1710 1487 900A BCC ALPH
1720 1489 C925 CMP #$25
1730 148B 9008 BCC NUM
1740 148D AA TAX
1750 148E BDBB15 LDA CHR-$25,X
1760 1491 D004 BNE PP
1770 1493 6928 ALPH ADC #$2B
1780 1495 6915 NUM ADC #15
1790 1497 A614 PP LDX XP
1800 1499 951F STA BFR,X
1810 149B E614 INC XP
1820 149D E002 CPX #2
1830 149F D006 BNE TSR
1840 14A1 C610 DEC BC
1850 14A3 A416 LDY YSU
1860 14A5 D0AF BNE LOOP4
1870 14A7 A5D8 TSR LDA $D8
1880 14A9 D004 BNE TSTX
1890 14AB A5D9 LDA $D?
1900 14AD F022 BEQ GADR
1910 14AF A615 TSTX LDX XSU
1920 14B1 1008 BPL LPREP
1930 14B3 A5D8 LDA $D8
1940 14B5 A000 LDY #0
1950 14B7 84D8 STY $D8
1960 14B9 F0CA BEQ NXCHR
1970 14BB A5D8 LPREP LDA $D8
1980 14BD 85DC STA $DC
1990 14BF A5D9 LDA $D9
2000 14C1 85DD STA $DD
2010 14C3 A416 LDY YSU
2020 14C5 D09D BNE LOOP5
2030 14C7 C610 XIT DEC BC
2040 14C9 3006 BMI GADR
2050 14CB A615 LDX XSU
2060 14CD A416 LDY YSU
2070 14CF D087 BNE LOOP4P
2080 14D1 A200 GADR LDX #0
2090 14D3 B51F GB$ LDA BFR,X
2100 14D5 20EFF JSR PRINT
2110 14D8 E8 INX
2120 14D9 E008 CPX #8
2130 14DB D0F6 BNE GB$#
2140 14DD A205 LDX #5
2150 14DF B533 LDA MP,X
2160 14E1 20ACEA JSR PHEX
2170 14E4 CA DEX
2180 14E5 B533 LDA MP,X
2190 14E7 20ACEA JSR PHEX
2200 14EA A000 LDY #0
2210 14EC A200 LDX #0
2220 14EE 8613 STX MCTR
2230 14F0 8612 STX CSU
2240 14F2 B91F00 LOOP6 LDA BFR,Y
2250 14F5 C8 INY
2260 14F6 C920 CMP #$20
2270 14F8 F01C BEQ CXIT

```

searched once for each symbol to be printed. This method is not as efficient as a true sort, but it requires less memory. For a table of 100 symbols, the output is only slightly slower than the rate at which characters are written to the screen. After the minimum equivalence has been found in a particular pass (lines 510-1280), the symbol is decoded into its ASCII value (lines 1290-2070). The ASCII representation of the symbol is searched for multiple characters and converted to the form used by the assembler for source code (e.g., L666 = \$4C363636 → \$4C36FE) (lines 2080-2530).

Next, the source file is searched for the line defining the symbol (lines 2540-2950). If the symbol is not defined (and this will have caused an assembler error) the lister program prints a ? instead of a line number. Additionally, if the symbol is more than two characters long, the fourth character will be an embedded ?. Finally, the symbol, its value, and the line number where defined are all printed out (lines 2960-3250). This process is repeated until all symbols have been found and printed out.

To conserve memory space, the program uses routines stored in BASIC ROM and in an extended monitor EPROM (EXMON, DVD, and PHEX). The jump to EXMON at the end of the program (line 870) may be replaced by a jump to the monitor (\$FE00) or to the assembler (\$1300). The routines for 16-bit division (DVD) and printing a hex character (PHEX) are listed for the benefit of those who do not have the extended monitor. Since the assembler begins at \$0240, PHEX can be relocated to \$0222-0238 and DVD to the end of memory, provided the contents of STS are changed from \$FF to \$DD.

The program as written here begins at \$1391 and runs to \$15E3. The value in STMEM has accordingly been changed to \$15E4. Note that this change must be made as soon as the assembler is loaded, before any source code is entered. This reduces the space available for an assembler source file by \$253 (595 decimal) locations. If this reduction in space turns out to be crucial, the lister could be relocated to overlay part of the assembler. If this is done, the part of the assembler to be overlaid should be stored on tape. The assembler can then be reused by loading only the short overlay file rather than the entire program. The lister uses some page-zero locations for storage, but does not change any values.

required by the assembler, so the assembler can be re-run after running the lister if so desired. Output goes to the print vector at \$FFEE which is a JMP (indirect) to \$021A, 021B. These locations are initialized by the monitor to send output to the screen or tape, depending on the value in \$0205. They can, of course, be changed to point to a print routine if a printer is available.

### Summary

This article presents a symbol table listing program written specifically for the cassette-based assembler furnished for the OSI C1P. The attached listing is followed by a symbol table printed out by this program. The assembler instruction manual appears to apply to the OS-65D version as well, though some addresses would need to be changed to run this lister program with it.

The author may be contacted at 13917 Congress Drive, Rockville, MD 20853.

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### Symbol Table Lister (continued)

```

2280 14FA C512      CMP CSU
2290 14FC F014      BEQ DUPL
2300 14FE 48        PHA
2310 14FF A513      LDA MCTR
2320 1501 F007      BEQ STOR
2330 1503 9527      STA DEST,X
2340 1505 E8        INX
2350 1506 A900      LDA #0
2360 1508 8513      STA MCTR
2370 150A 68        STOR PLA
2380 150B 9527      STA DEST,X
2390 150D E8        INX
2400 150E 8512      STA CSU
2410 1510 D8E8      BNE LOOP6
2420 1512 C613      DUPL DEC MCTR
2430 1514 D8DC      BNE LOOP6
2440 1516 A513      CXIT LDA MCTR
2450 1518 F003      BEQ CRTN
2460 151A 9527      STA DEST,X
2470 151C E8        INX
2480 151D 8611      CRTN STX CC
2490 151F A920      LDA ##20
2500 1521 9527      STA DEST,X
2510 1523 E8        INX
2520 1524 E008      CPX #8
2530 1526 D0F7      BNE CRTN+2
2540 1528 ACC912     LDY STMEM
2550 152B ADCA12     LDA STMEM+1
2560 152E 851E      STA PTR2+1
2570 1530 A900      LDA #0
2580 1532 851D      STA PTR2
2590 1534 A200      GORD LDX #0
2600 1536 CCFE12     CPY NL
2610 1539 D00A      BNE GORD
2620 153B A51E      LDA PTR2+1
2630 153D CDFF12     CMP NL+1
2640 1540 D003      BNE GORD.
2650 1542 4CC415     JMP QUEST
2660 1545 20D215     GORD. JSR INCY
2670 1548 8517      STA LN
2680 154A 20D215     JSR INCY
2690 154D 8518      STA LN+1
2700 154F 20D215     LS  JSR INCY
2710 1552 38FB      BMI LS
2720 1554 C920      CMP ##20
2730 1556 F0F7      BEQ LS
2740 1558 D003      BNE TNC
2750 155A 20D215     NC  JSR INCY
2760 155D D527      TNC CMP DEST,X
2770 155F D00A      BNE NXLN$#
2780 1561 E8        INX
2790 1562 E411      CPX CC
2800 1564 F00E      BEQ FOUND
2810 1566 D8F2      BNE NC
2820 1568 20D215     NXLN JSR INCY
2830 156B C90D      NXLN$# CMP ##0D
2840 156D F8C5      BEQ GORD
2850 156F 20D215     JSR INCY
2860 1572 D8F7      BNE NXLN$#
2870 1574 20D215     FOUND JSR INCY
2880 1577 C920      CMP ##20
2890 1579 F00C      BEQ TRFIND
2900 157B C90D      CMP ##0D
2910 157D F008      BEQ TRFIND
2920 157F C92A      CMP #'*
2930 1581 F004      BEQ TRFIND
2940 1583 C93D      CMP #'=
2950 1585 D0E4      BNE NXLN$#
2960 1587 A517      TRFIND LDA LN
2970 1589 85AE      STA $AE
2980 158B A518      LDA LN+1
2990 158D 85AD      STA $AD
3000 158F A290      LDX ##$0
3010 1591 38        SEC
3020 1592 28E8B7     JSR BFF
3030 1595 28E6B9     JSR BPF
3040 1598 A000      LDY #0
3050 159A B90001     T2  LDA BCB,Y
3060 159D F803      BEQ NX
3070 159F C8        INY
3080 15A0 D0F8      BNE T2
3090 15A2 98        NX  TYA
3100 15A3 49FF      EOR ##FF
3110 15A5 18        CLD

```

DECREMENT MCTR FOR EACH MULTIPLE CHARACTER  
IF NO DUPLICATE THEN EXIT  
STORE NEGATIVE VALUE IN DEST IF DUPLICATE CHAR  
NOW DEST IS IN ASM SOURCE FORMAT

SET UP SEARCH OF SOURCE CODE FOR SYMBOL

IF SOURCE EXHAUSTED AND NO MATCH FOUND THEN PRINT ?

SKIP LEADING BLANKS BOTH SINGLE AND MULT.

COMPARE SOURCE CODE TO SAVED SYMBOL

MATCH OF CORRECT # OF CHARACTERS

IF FOLLOWED BY TERMINATOR THEN TRUE FIND ELSE BURIED IN LONGER SYMBOL CONTINUE SEARCH

SET UP CALL TO BASIC CONVERSION ROUTINES

CONV HEX TO DECIMAL CONV DEC TO ASCII STORED STARTING AT \$0100 SEARCH BCB FOR TERMINATOR ADJUST LEADING SPACES SO NUMBER IS RIGHT-JUSTIFIED

**Symbol Table Lister (continued)**

```

3120 15A6 6908      ADC #8
3130 15A8 A8        TAY
3140 15A9 A920      SB: LDA #$20
3150 15AB 20EEFF    SB  JSR PRINT
3160 15AE 88        DEY
3170 15AF D0FA      BNE SB
3180 15B1 A000      LDY #0
3190 15B3 B90001    SN  LDA BCB,Y      PRINT LINE NUMBER
3200 15B6 F006      BEQ PXIT
3210 15B8 20EEFF    JSR PRINT
3220 15B8 C8        INY
3230 15BC D0F5      BNE SN
3240 15BE 206CAB    PXIT JSR CRL
3250 15C1 4C8013    JMP LOOP1      CONTINUE
3260 15C4 A93F      QUEST LDA #??
3270 15C6 8D0001    STA BCB      SYMBOL NOT FOUND IN
3280 15C9 A900      LDA #0      SOURCE PRINT ?
3290 15CB 8D0101    STA BCB+1
3300 15CE A006      LDY #6
3310 15D0 D0D7      BNE SB:
3320 15D2 B11D      INCY LDA (PTR2),Y
3330 15D4 C8        INY
3340 15D5 D002      BNE IXT
3350 15D7 E61E      INC PTR2+1
3360 15D9 48        IXT PHA
3370 15DA 68        PLA
3380 15DB 60        RTS
3390 15DC ; DIVISORS FOR CODED LABELS
3400 15D0 00        DVS .BYTE 0,$28,6,$48
3400 15DD 28
3400 15DE 06
3400 15DF 40
3410 15E0 ; NON-ALPANUMERICs ALLOWED IN LABELS
3420 15E0 3A        CHR .BYTE ':.$?'
3420 15E1 2E
3420 15E2 24
3420 15E3 3F
3430 EAAC      *==$EAAC
3440 EAAC      ; PHEX
3450 EAAC 48      PHA
3460 EAAD 4A      LSR A
3470 EAAE 4A      LSR A
3480 EAAF 4A      LSR A
3490 EAB0 4A      LSR A
3500 EAB1 20B5EA    JSR PH1
3510 EAB4 68      PLA
3520 EAB5 290F      PH1 AND #$0F
3530 EAB7 0930      ORA #$30
3540 EAB9 C93A      CMP #$3A
3550 EABB 9002      BCC PH2
3560 EABD 6906      ADC #6
3570 EABF 4CEEFF    PH2 JMP PRINT
3580 EE61      *==$EE61
3590 EE61      ; DIVIDE ROUTINE
3600 EE61 26DC      DIVIDE ROL $DC
3610 EE63 26D0      ROL $DD
3620 EE65 CA        DEX
3630 EE66 3017      BMI DV1
3640 EE68 26D8      ROL $D8
3650 EE6A 26D9      ROL $D9
3660 EE6E ; DVD      ENTRY TO DIVIDE ROUTINE
3670 EE6C 38        SEC
3680 EE6D A5D8      LDA $D8
3690 EE6F E5DE      SBC $DE
3700 EE71 A8        TAY
3710 EE72 A5D9      LDA $D9
3720 EE74 E5DF      SBC $DF
3730 EE76 90E9      BCC DIVIDE
3740 EE78 85D9      STA $D9
3750 EE7A 98        TYA
3760 EE7B 85D8      STA $D8
3770 EE7D B0E2      BCS DIVIDE
3780 EE7F A4DD      DV1 LDY $DD
3790 EE81 A6DC      LDX $DC
3800 EE83 60        RTS

```

**Sample Symbol Table Listing**

ALPH	1493	1770
BC	0010	50
BCB	0100	220
BFF	B7E8	280
BFR	001F	160
BPF	B96E	290
CC	0011	60
CHR	15E0	3420
CL0OP	13FA	910
CM1	13F6	880
CONT	13F7	890
CPM	143F	1340
CRL	A86C	270
CRTN	151D	2480
CSV	0012	70
CTR0	0064	200
CXIT	1516	2440
DEST	0027	170
DIVIDE	EE61	3600
DUPL	1512	2420
DVD	EE6C	320
DVS	15DC	3400
DV1	EE7F	3780
EXM	E800	300
FOUND	1574	2870
GADR	14D1	2080
GB\$	14D3	2090
GORD	1534	2590
GORD,	1545	2660
INCY	1502	3320
IXT	15D9	3360
LL	000A	40
LN	0017	120
LOOP1	13B0	510
LOOP2	13B4	530
LOOP3	13C0	580
LOOP3.	144E	1420
LOOP4	1456	1460
LOOP4P	1458	1470
LOOP5	1464	1530
LOOP6	14F2	2240
LPREP	14B8	1970
LS	154F	2700
LW	0019	130
M	002F	180
MCTR	0013	80
MP	0033	190
MUMP	1423	1170
NC	155A	2750
NL	12FE	260
NUM	1495	1780
NX	1542	3090
NXCHR	1485	1700
NXLN	1568	2820
NXLNB	156B	2830
NXWORD	1431	1260
PFL	0285	230
PHEX	EAAC	310
PH1	EAB5	3520
PH2	EABF	3570
PP	1497	1790
PRINT	FFEE	330
PRNT	1436	1290
PTR	001B	140
PTR2	001D	150
PXIT	15BE	3240
QUEST	15C4	3260
SB	15AB	3150
SB:	15A9	3140
SN	15B3	3190
STB	143A	1310
STMEM	12C9	240
STOR	150A	2370
STRT	1391	360
STRZER	1478	1630
STS	12CB	250
TMP	141D	1130
TNC	155D	2760
TRFIND	1587	2960
TRN	13D2	680
TSR	14A7	1870
TSTX	14AF	1910
TZ	155A	3050
XIT	14C7	2030
XP	0014	90
XSV	0015	100
YSV	0016	110

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## Resource Update

**A list of magazines which contain information about the 6502/6809 microprocessors on a reasonably regular basis.**

Did you ever wonder just what magazines are rich sources of information on the 6502/6809 microprocessors, 6502/6809-based microcomputers, accessory hardware and software? For several years this writer has been assembling a bibliography of 6502/6809 references related to hobby and small business systems. The accompanying list of magazines has been compiled from this bibliography. An attempt has been made to give up-to-date addresses and subscription rates for the magazines cited. Subscription rates are for the U.S. Rates to other countries normally are higher.

### GENERAL 6502/6809

**MICRO: The 6502/6809 Journal**  
\$24.00 per year, 12 issues  
P.O. Box 6502  
Chelmsford, MA 01824

**Compute!**  
\$20.00 per year, 12 issues  
515 Abbott Drive  
Broomall, PA 19008

### GENERAL COMPUTER

**Byte**  
\$19.00 per year, 12 issues  
Byte Subscriptions  
P.O. Box 590  
Martinville, NJ 08836

**Computer Shopper**  
\$10 per year, 12 issues  
Glenn Patch, Editor  
P.O. Box F  
Titusville, FL 32780

**Computing Today**  
£15.15, 12 issues  
Argus Specialists Publications, Ltd.  
145 Charing Cross Road  
London WC2H 0EE  
England

**Creative Computing**  
\$20.00 per year, 12 issues  
P.O. Box 789-M  
Morristown, NJ 07960

**CSRA Computer Club Newsletter**  
\$6.00 per year  
P.O. Box 284  
Augusta, GA 30903

**Dr. Dobb's Journal**  
\$21.00 per year, 12 issues  
People's Computer Co.  
P.O. Box E  
1263 El Camino Real  
Menlo Park, CA 94025

**Epson Information Exchange Newsletter**  
\$12.00 per year, 12 issues  
Epson Users Group  
c/o Frank Barden  
136 Candlewick Drive  
Wendell, NC 27591

**IEEE Micro**  
\$23.00 per year, quarterly  
IEEE Computer Society  
10662 Los Vaqueros Circle  
Los Alamitos, CA 90720

**Interface Age**  
\$18.00 per year, 12 issues  
McPheters, Wolfe and Jones  
16704 Marquardt Ave.  
Cerritos, CA 90701

**Microcomputing**  
\$25.00 per year, 12 issues  
Wayne Green, Inc.  
80 Pine Street  
Peterborough, NH 03458

**Microcomputer Index**  
\$30.00 per year, quarterly  
Microcomputer Information Services  
2646 El Camino Real, Box 247  
Santa Clara, CA 95051

**Personal Computer World**  
£ 8.00, 12 issues  
Sportscene Publishers (PCW) Ltd.  
14 Rathbone Place  
London W1P 1DE  
England

**Personal Computing**  
\$18.00 per year, 12 issues  
Hayden Publishing Co.  
4 Disk Drive, Box 1408  
Riverton, NJ 08077

**Popular Computing**  
\$15.00 per year, 12 issues  
Byte Publications  
P.O. Box 307  
Martinville, NJ 08836

**Practical Computing**  
£ 10.00, 12 issues  
IPC, Business Press, Ltd.  
Quadrant House  
The Quadrant, Sutton  
Surrey SM2 5AS  
England

**Purser's Magazine**  
\$12.00 per year, 4 issues  
c/o Robert Purser  
P.O. Box 466  
El Dorado, CA 95623

**SoftSide**  
\$30.00 per year, 12 issues  
P.O. Box 68  
Milford, NH 03055

**Spreadsheet**  
\$25.00 per year  
Visigroup—Visicalc User Group  
P.O. Box 254  
Scarsdale, NY 10583

### APPLE-RELATED PUBLICATIONS

**The Abacus II Newsletter**  
\$18.00 per year, 6 issues  
5302 Camino Alto Mira  
Castro Valley, CA 94546

**Adam and Eve Newsletter**  
\$12.00 per year  
Adam and Eve Apple II Users' Group  
11 South Hancock Street  
Madison, WI 53703

**Apple**  
\$2.00 per issue, quarterly  
Apple Computer Co.  
10260 Bandley Drive  
Cupertino, CA 95014

**Apple Assembly Line**  
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Dallas, TX 75228

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(continued)

## Resource Update (continued)

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### Applegram

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Apple's British Columbia Computer Society  
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Richmond, B.C.,  
Canada V6Y 1S2

### Apple Gram

\$15.00 per year, 12 issues  
The Apple Corps of Dallas  
P.O. Box 5537  
Richardson, TX 75080

### Apple Mug Newsletter

Apple Medical User's Group  
2914 Katella, Suite 208  
Orange, CA 92667

### The Apple Orchard

\$10.00 per year, 6 issues  
International Apple Core  
910 A George St.  
Santa Clara, CA 95050

### Apple Peel

\$20.00 per year, 12 issues  
Jerry Jenkins, Editor  
The Birmingham Apple Corps  
774 Twin Branch Drive  
Birmingham, AL 35226

### Apple/Sass

\$12.00 per year, 12 issues  
Honolulu Apple User's Society  
P.O. Box 91  
Honolulu, HI 96810

### Applesauce

\$12.00 per year, 6 issues  
Original Apple Corps  
P.O. Box 598  
Venice, CA 90291

### AppleSeed Newsletter

\$15.00 per year, 12 issues  
P.O. Box 12455  
San Antonio, TX 78212

### ByteLines

\$12.00 per year, 12 issues  
Hi Desert Apple Computer Club  
P.O. Box 2702  
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\$20.00 per year, 12 issues  
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304 Main Ave. S., Suite 300  
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### The Cider Press

\$20.00 per year, 12 issues  
San Francisco Apple Core  
1515 Sloat Blvd., Suite 2  
San Francisco, CA 94132

### The C.I.D.E.R. Press

\$10.00 per year  
Apple Computer Information and Data Exchange of Rochester  
P.O. Box 2359  
Rochester, NY 14623

### Erie Apple Crunchers Express

\$12.00 per year  
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\$12.00 per year, 12 issues  
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P.O. Box 31424  
Raleigh, NC 27622

### FWAUG Newsletter

\$15.00 per year, about 9 issues  
Lee Meador, Editor  
Fort Worth Area Apple User Group  
1401 Hillcrest Drive  
Arlington, TX 76010

### The G.R.A.P.E. Vine

\$7.50 per year, 12 issues  
Group for Religious Apple Programming Exchange  
c/o Stephen Lawson  
P.O. Box 283  
Port Orchard, WA 98366

### Hardcore Computing

\$20.00 per year, quarterly  
P.O. Box 44549  
Tacoma, WA 98444

### The Harvest

\$12.00 per year, 10 issues  
Northern Illinois Apple User Group  
1015 S. Ridge Rd.  
Arlington Heights, IL 60005

### L.A.U.G.H.S.

\$15.00 per year  
c/o Sam Ward  
Louisville Apple User Group  
8002 Canna Dr.  
Louisville, KY 40258

### Maple Orchard

\$25.00 (Canadian) per year, 6 issues  
Apple Users Group of Toronto  
(Apple-Can)  
P.O. Box 696  
Willowdale, Ont.,  
Canada M2K 2P9

### The Michigan Apple-Gram

\$12.00 per year, 10 issues  
The Michigan Apple Computer Club  
P.O. Box 551  
Madison Heights, MI 48071

### Mini'App'Les Newsletter

\$12.00 per year  
Mini'App'Les Apple Computer User Group  
Box 796  
Hopkins, MN 55343

### Newsletter

\$10.00 per year  
Apple Bytes of Buffalo  
c/o Hank Kolk  
171 Tree Haven Road  
Buffalo, NY 14215

### Nibble

\$19.95 per year, 8 issues  
S.P.A.R.C.  
P.O. Box 325  
Lincoln, MA 01773

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\$10.00 per year, 6 issues  
OKC Apple User Group  
c/o Glenn H. Rodkin  
3728 No. Frankford  
Oklahoma City, OK 73112

### Peelings II

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The Peelings Co.  
P.O. Box 188  
Las Cruces, NM 88004

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5707 Chesapeake Way  
Fairfield, OH 45014

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c/o Ken Gabelman  
849 Russel Ave.  
Akron, OH 44307

### The Scarlet Letter

Big Red Apple Club  
1301 North 19th  
Norfolk, NE 68701

### The Seed

\$18.00 per year, 12 issues  
P.O. Box 17467  
Denver, CO 80217

### Softline

Gratis, 6 issues per year  
11021 Magnolia Blvd.  
North Hollywood, CA 91601

(Continued on page 110)



## Software Catalog

**Name:** **Payroll System**  
**System:** OS65U  
**Memory:** 48K  
**Language:** BASIC  
**Hardware:** OSI C-2 or C-3 series

Description: This integrated portion of EIS General Accounting System prepares payroll for hourly and salaried employees while accumulating information for tax reporting purposes. It includes all tax tables and optional payroll check writing.

Price: \$800.00

Includes three program disks and a step-by-step user's manual

Available:  
 Electronic Information Systems, Inc.  
 P.O. Box 5893  
 Athens, GA 30604  
 (404) 353-2858

**Name:** **The Home Accountant**  
**System:** Apple II, 1 disk drive (2nd recommended)  
**Memory:** 48K  
**Language:** Applesoft  
**Hardware:** Applesoft in ROM, printer (132-column optional but recommended)

Description: Package offers a 100-budget category, keeps track of up to 5 checking accounts, cash and credit cards. Prints checks (if desired), prints a personal balance sheet and net worth statement. Allows multiple diskettes, fast bank reconciliation, and automatic transfers. Custom search and retrieval, and graphics for any category by bar graph, line graph and trend analysis.

Price: \$74.95 (Retail)  
 Includes one program diskette, manual and binder

Authors: Robert Schoenbong, Stephen Pollack, Larry Grodin

Available:  
 Continental Software  
 16724 S. Hawthorne Blvd.  
 Lawndale, CA 90260  
 (213) 371-5612

**Name:** **Stock Forecasting System**  
**System:** Apple II Plus or equivalent  
**Memory:** 48K  
**Language:** BASIC  
**Hardware:** One disk drive minimum. Can use 2 drives, printer modem and graphics tablet.

Description: Fifteen menu-driven programs are used to determine buy and sell points for individual stocks. *System* provides technical analysis of stock prices. Complete data file control. Programs are locked, but user may make unlimited copies for his own use.

Price: \$175  
 Includes program diskette, data disk, hardware lock and manual

Author: C. Edward Walter  
 Available:  
 Urban Aggregates, Inc.  
 6431 Brass Knob  
 Columbia, MD 21044

**Name:** **Elements of Music**  
**System:** Micro Plato/Apple II Plus  
**Memory:** 48K  
**Language:** Micro Tutor, Applesoft BASIC  
**Hardware:** One disk drive  
 Description: This computer program was developed for use with children and non-music majors who wish to learn the elements in music at an entry level. Content lessons include: pitch names, pitches on the keyboard, key signatures. Lesson disk includes student records for 50 users with data collection for all lessons on the disk.

Price: \$175 Apple  
 \$225 Micro Plato  
 Includes instructor manual, student instruction sheet, floppy disk lesson.

Author: John M. Eddins, Robert L. Weiss, Jr.

Available:  
 Electronic Courseware Systems, Inc.  
 P.O. Box 2374, Station A, Champaign, IL 61820

**Name:** **Arith-Magic**  
**System:** PET  
**Memory:** 16K  
**Language:** BASIC  
**Hardware:** Diskette and Tape

Description: These three mathematics programs — Diffy, Tripuz and Magic Squares — are highly interactive and present motivated practice in whole number operations along with exploration of concepts. They are appropriate for grades 3-8 and come with thorough teacher documentation.

Price: \$35.00  
 Includes postage and handling  
 Author: Joanne B. Rudnytsky  
 Available:  
 Quality Educational Designs  
 P.O. Box 12486  
 Portland, OR 97212

**Name:** **Russian Disk**  
**System:** Apple  
**Memory:** 32K  
**Hardware:** Disk Drive  
 Description: The *Russian Disk* package contains two sets of programs: the first set teaches the Russian (or Cyrillic) Alphabet by first introducing the letters that most resemble their English counterparts and then the more exotic ones bit by bit. The second set of programs develops reading ability in Russian and expands the user's Russian vocabulary. It also provides a chance to practice typing in Russian using the Cyrillic characters learned in part one.

Price: \$24.95  
 Author: Constance Curtin  
 Available:  
 Instant Software, Inc.  
 Peterborough, NH 03458  
 (603) 924-9471

**Name:** **Waterloo microPascal**  
**Hardware:** Commodore SuperPET, Volker-Craig 2900, 3900, 4900, Northern Digital microWAT

Description: *Waterloo microPascal* is an extensive implementation of Pascal, corresponding very closely to draft

proposals being produced by the International Standards Organization (ISO) Pascal committee. The ISO draft language is a refinement of the language originally defined by Wirth, varying only in minor aspects. This implementation includes sophisticated features such as text file support, pointer variables, and multi-dimensional arrays. A significant feature of Waterloo microPascal is its powerful interactive debugging facility.

Available:  
 Waterloo Computing Systems Limited  
 158 University Ave. W.  
 Waterloo, Ontario, Canada  
 N2L 3E9

**Name:** **Liquid and Gas Flow Calculation**  
**System:** Apple II, Apple II Plus  
**Memory:** 32K  
**Language:** Applesoft BASIC  
**Hardware:** DOS 3.2 II or DOS 3.3 II with controller card

Description: Menu-driven flow calculation programs, to find physical properties on flow of gases or liquid for tube data engineering. Two main programs calculate quantity, inlet pressure, outlet pressure, flow coefficient, specific gravity, temperature, selected tubing material's outer diameter's allowable wall thickness. Also includes tube volume calculation program. Considers the elevated temperature in high-pressure condition of unknown medium. Utilizes several sophisticated exponential calculation routines to find ultimate pressure ratings of both tubing data (aluminum, copper, carbon steel and two kinds of stainless steel) are stored in data file.

Price: \$40.00  
 Includes seven programs on diskette.

Available:  
 American Avicultural Art & Science Inc.  
 3268 Watson Road  
 St. Louis, MO 63139  
 (314) 645-4431

(Continued on next page)

# Wizard-80™

## INSTANT 80 COLUMN APPLE\*

The miracle of the 80's... everything you want in an 80-column card.

### STOP STARING AT 40 COLUMNS

WIZARD-80 lets you see exactly what you will get when typing 80-column format. It gives you a full 80-column by 24-line display with all these features.

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- Fully compatible with most word processors, micro-modems and prom programmers, plus all current Apple II expansion boards
- Lists BASIC programs, integer and Applesoft
- Fully compatible with Pascal
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- Displays 7x9 matrix characters
- Provides upper/lower case characters with full descenders
- Fully edits...uses ESCape key for cursor movement
- Scrolling stop/start uses standard Control-S entry
- Retains text on screen while it is being printed
- Contains crystal clock for flicker-free character display
- Has low power consumption for cool reliable operation
- Leads soldered directly to board for maximum reliability
- 2K on-board RAM, 50 or 60 Hz operation
- Inverse video selection standard

Available at all fine Computer Stores \$295.00



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WIZARD-80  
YOUR INSTANT  
80-COLUMN APPLE

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Everything you want in an 80-column card. It lets you see exactly what you will get when typing 80-column format. It gives you a full 80-column by 24-line display with all these features: Fully compatible with most word processors, micro-modems, prom programmers, plus all current Apple II expansion boards. Fully compatible with Pascal. Uses software to switch between 40 and 80 column formats. Displays 7x9 matrix characters. Provides upper/lower case characters with full descenders. Fully edits...uses standard Control-S entry. Scrolling stop/start uses standard Control-S entry. Retains text on screen while it is being printed. Contains crystal clock for flicker-free character display. Low power consumption for cool reliable operation. Leads soldered directly to board for maximum reliability. 2K on-board RAM, 50 or 60 Hz operation. Interface standard. The WIZARD-80 is available at all fine Computer Stores.

It comes to you from  
Wesper Micro Systems,  
a subsidiary of  
Wespercorp

## Software Catalog (continued)

Name: **Escape From Arcturus**

System: Apple II

Memory: 48K

Language: Applesoft/  
Machine Code

Hardware: DOS 3.3

Description: This machine-language program has colorful high-resolution animation along with sound effects. The two-part player action begins with commanding the Space Fortress. Surrounded by attacking Gripplers, you fend off photon torpedoes, fighters, cruisers, and deal with their force fields — all at the same time. Moving to the escape pilot mode, you repel a variety of landing craft while saving the population of Arcturon. Requires an Apple II with Applesoft firmware, 48K, DOS 3.3 system with paddles, and quick reflexes.

Price: \$35

Available:

Synergistic Software  
5221 120th Ave. S.E.  
Bellevue, WA 98006

Name: **Absolute Security**

System: Apple II and Apple II Plus, DOS 3.3

Memory: 48K Bytes

Language: Applesoft BASIC,  
Machine Code  
(6502)

Hardware: Small audio  
amplifier (any  
cassette recorder),  
Micromodem II

Description: *Absolute Security* protects confidential modem communications by encoding uppercase ASCII text files with an *unbreakable* code. The security of the system relies on user-generated keys. It is, therefore, possible for every Apple user to own and use *Absolute Security* with equal total privacy and protection. Based on the "One-Time Pad" concept, *Absolute Security* is invulnerable to decoding by even Government superpowers.

Price: \$79.95 ppd. in the USA  
Includes operation/ configuration manual, 3.3 diskette, 2-system license

Author: Dann McCreary

Available:

Dann McCreary Software  
Box 16435-MI  
San Diego CA 92116

Note: *Absolute Security* is currently available only for shipment within the U.S., per U.S. State Department directive. Foreign inquiries only accepted.

Name: **Job Control System™**

System: Apple III

Memory: 64K

Language: Pascal

Hardware: Apple II with  
Pascal language  
and a 132-column  
printer

Description: High Technology Software Products, Inc. brought computer-assisted job control to the small-to-medium-size companies in manufacturing, construction, and service industries by introducing the *Job Control System™* for the Apple II early in 1981. JCS is now available for the Apple III. JCS provides management with reliable measures of productivity by furnishing up-to-the-minute job status data for determining the real cost of producing a product or providing a service.

Price: \$750.00

Includes program diskette,  
3-ring binder with complete  
documentation

Author: Mark Netttingham

Available:

High Technology Software  
Products, Inc.

P.O. Box 14665

2201 N.E. 63rd St.

Oklahoma City, OK 73113  
and other computer retailers  
worldwide

Name: **Vigil**

System: VIC-20

Memory: 4K

Language: Assembler

Hardware: VIC with 3K  
memory expander

Description: A powerful new language for programming interactive games. Allows use of all features available on VIC (color, sound, light pen, game paddles and joysticks). With Vigil you can create action-packed games that rival machine-language coded games in speed, but in a fraction of the development time. Comes with nine preprogrammed games to get you started immediately.

Price: \$35.00

Includes 80-plus-page  
manual and nine full length  
sample games

Author: Roy Wainwright

Available:

Abacus Software  
P.O. Box 7211  
Grand Rapids, MI 49510  
(616) 241-5510

## Software Catalog

(continued)

Name: **Waterloo microSUPER-VISOR**

Hardware: Commodore SuperPET, Volker-Craig 2900, 3900, 4900, Northern Digital microWAT

Description: The *Waterloo microSUPERVISOR* is an operating system designed for single-user microcomputer environments. It includes monitor, library and serial line communications support. The monitor program supports loading of linker-produced program files into bank-switched RAM memory or normal RAM memory. The monitor also provides facilities which are useful for debugging machine-language programs. A library of functions and procedures is included for general use by other programs included in the package. The library includes support functions for input/output operations to the keyboard, screen and peripheral devices. A serial line setup program is included which permits the selection of programmable characteristics, such as baud rate, of RS-232 serial lines. In addition, this program includes support for establishing communication with a host computer, through a serial line, for the purpose of accessing its files and peripheral devices.

Available:

Waterloo Computing Systems Limited  
158 University Ave. West  
Waterloo, Ontario  
Canada N2L 3E9

Name: **Math Drill Gamepac**

System: OSI C1P, Superboard; TRS-80 Model I, III  
Memory: OSI - 8K TRS-80 - 16K

Language: BASIC

Hardware: Cassette

Description: *Math Drill Gamepac* consists of three separate games for making math drills fun. Math Wars provides random drill problems in BASIC addition, subtraction, multiplication, and division with a choice of difficulty from one- to three-digit numbers. Fraction-Action follows the dreaded Gator-Hator at feeding time while drilling at all aspects of fractions. Decimal

Tic-Tac-Toe requires correct answers to decimal problems in order to play the popular game. Excellent for grades K through 6.

Price: \$11.95 per game  
\$29.95 for complete

Gamepac  
Add \$2.00 for shipping  
Includes separate tape for each game, instructions

Author: Doug Jenkins and Garry Taylor

Available:  
Tripod Productions  
Box 71, Route 11  
Bowling Green, KY 42101

Name: **BASXR**

System: OS65U

Memory: 48K

Language: BASIC

Hardware: Ohio Scientific C-2 or C-3 series

Description: Helps with debugging and modification. Lists all variables and/or commands and their line number locations. Locates specific lines on entry of decimal value of BASIC commands.

Price: \$45 - program  
\$50 put on your OS65U disk  
Includes program listing and documentation manual.

Available:  
Electronic Information Systems, Inc.  
P.O. Box 5893  
Athens, GA 30604  
(404) 353-2858

Name: **Electronics III #26014**

System: Apple II or Apple II Plus

Memory: 32K RAM

Language: Applesoft

Description: The programs in this package are used to analyze both periodic and aperiodic waveforms along with various circuits: average and RMS values of a periodic function, fourier series expansion of a periodic function; fourier transform and spectrum plot, analysis of damped oscillations, impedance matching pads, and PI-TEE (delta-wye) transforms.

Price: \$39.95  
Includes documentation.

Available:  
Advanced Operating Systems  
450 St. John Rd.  
Suite 792  
Michigan City, IN 46360  
(219) 879-4693

(Continued on next page)

# Wizard-BPO™

## BUFFERED PRINTER OUTPUT

Allows new-task input while old-task prints out.

### STOP WAITING FOR SLOW PRINTER OPERATION

WIZARD-BPO is a parallel printer interface that lets you use your Apple while data from a previous operation is being printed. No more wasting of your precious time while your printer prints. The WIZARD-BPO contains a 16K byte "character buffer" that may be expanded to 32K bytes of character buffering. It accepts data at the Apple's rapid transfer rate, stores the data and feeds it to your printer at the rate the printer can accept it.

■ Fully compatible with all Apple II and Apple II Plus\* computers



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## NEW 6809 SYSTEM!

Now, for about the same price as you would expect to pay for the memory capacity alone, you can have a complete single board computer with these features:

- 6809 CPU, 1MHz clock
- 192KB RAM included, sockets for 64KB more
- 84X24 display of a 7X12 character font
- Keyboard interface for an un-encoded switch matrix
- Floppy controller for two 5" drives, single or double sided, up to 80 tracks
- Parallel printer port
- Serial I/O port
- General purpose 8-bit parallel I/O port
- Parallel expansion port
- Dimensions: 8.6 by 10.3 inches

The FLEX operating system is supported by our device drivers. BASIC, PASCAL, and C are available for FLEX. The device drivers (in EPROM) include advanced features like auto-repeat for the keyboard, and track buffering for the disks. Commented source code of all EPROM contents is supplied.

For more information, send a stamped self-addressed envelope and we will send you a configuration guide that explains how to set-up a system. An assembled board is purchased by sending check or money order for \$735 per board. (California add 6% sales tax).

### Chandler Microsystems

22051 COSALA  
MISSION VIEJO, CA 92691

FLEX, trademark Technical Systems Consultants, Inc.

## COMING SOON...

The fastest, most comprehensive, most responsive software ever written for microcomputers...

**FEDDER SOFTWARE** by Interactive Computer Systems, for CP/M multi-user hard disk environment...

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**PRIME  
FACTOR, Inc.**

### PRIME FACTOR BASIC 2.2

the PRIME FACTOR, Inc. presents PRIME FACTOR BASIC, a fast and powerful Applesoft™ compatible, 500 digit machine language math system. 211634147127000

PRIME FACTOR BASIC provides the tools to play the 3000 year old adventure game of large numbers. With the added commands you may explore for large mersenne primes, compute the natural logarithm e to 500 places, factor large numbers, experiment with a 129 digit public key trap door function and much more.

PRIME FACTOR BASIC is delivered on an Apple II DOS 3.3 diskette with numerous demonstration programs. The user manual takes you step by step through the easy commands which form a natural extension to Applesoft. Simple and array variables are supported. The functions +, -, ×, ÷, ^, ABS(X), SGN(X), MOD(X/Y), MOD(X^Y/Z), GCD(X,Y), SQR(X), SQREM(X), LEN(X) and IF...THEN testing are some of the tools available in this mathematics adventure package.

**PRIME FACTOR BASIC** ..... \$79.95

California residents add 6% tax.

Apple II, Applesoft and DOS 3.3 are trademarks of Apple Computer Inc.  
PRIME FACTOR BASIC and PRIME FACTOR LOCK are trademarks of the PRIME FACTOR, Inc.

14713 OXNARD STREET • VAN NUYS, CA 91411 • (213) 908-1838

## Software Catalog (continued)

**Name:** **Videotrek**  
**System:** OSI Cassette Systems  
**Memory:** 8K  
**Language:** BASIC  
**Description:** Command the Starship "Challenger" on a high-speed chase through the galaxy as you try to destroy the Klingon invasion fleet. You must navigate through stars, black holes and planets, and watch out for the doomsday machine! From the author of *Time Trek*, this is an action graphics arcade version of *Star Trek*, with several levels of difficulty. Uses machine code and has sound for all C1Ps and color and sound for C4Ps. Cassette only. Specify your system!  
**Price:** \$9.95  
**Author:** Bob Retelle  
**Available:**  
 Pretzeland Software  
 2005 Whittaker Rd.  
 Ypsilanti, MI 48197  
 (313) 483-7358

**Name:** **Time Dungeon -World #26052**  
**System:** Apple II or Apple II Plus  
**Memory:** 32K RAM  
**Language:** Applesoft  
**Description:** This game package offers the user three different games, each focusing on a different time period. The operator must answer questions correctly in order to map his way out of a dungeon with as many pieces of gold as possible. The time period focused upon depends upon the game chosen. The three programs are: Ancient History 4,000 BC-6BC; World History WW I 1894-1919; World History WW II 1933-1945.  
**Price:** \$29.95  
 Includes documentation  
**Available:**  
 Advanced Operating Systems  
 450 St. John Road  
 Suite 792  
 Michigan City, IN 46360

**Name:** **Color Pac Attack**  
**System:** Radio Shack Color Computer, TRS-80C  
**Memory:** 16K  
**Language:** Assembly  
**Hardware:** TRS-80C, joysticks  
**Description:** *Pac Attack* brings the fun of the arcades to the

Color Computer. Three little muggers chase your man relentlessly around a maddening maze as you furiously try to build up points. This game's great graphics and sound effects offer continuous action at three levels of difficulty for computer buffs of all ages.  
**Price:** \$24.95  
 Includes cassette and instructions  
**Author:** Computerware  
**Available:**  
 Computerware  
 P.O. Box 668  
 Encinitas, CA 92024

**Name:** **Tax-Manager**  
**System:** Apple II or Apple II Plus  
**Memory:** 48K  
**Language:** Applesoft in ROM  
**Hardware:** Disk II  
**Description:** Get help preparing your federal income taxes and printing the schedules. This easy-to-use program includes the latest tax laws and will remain current with our Extended Warranty option.  
**Price:** \$150.00  
**Author:** Taso  
**Available:**  
 Micro Lab  
 2310 Skokie Valley Rd.  
 Highland Park, IL 60035

**Name:** **TWERPS**  
**System:** Apple II or Apple II Plus  
**Memory:** 48K  
**Language:** Assembly  
**Hardware:** Disk II  
**Description:** Now, from the company that brought you *Sneakers*, *Beer-Run* and a host of other blockbusters, comes *TWERPS* — another whimsical game of skill with eight levels of play and a cast of top-starring characters. Meet Captain Twerp! Thrill at the shooting Oribters! Be amazed by the swooping Glingas! Gasp in terror at the drooling Gleepnoks! Sit on the edge of your seat as you try to get back to the mother ship before your fuel runs out! Now at your neighborhood stores.  
**Price:** \$29.95  
 Includes diskette and instruction booklet  
**Author:** Dan Thomson  
**Available:**  
 Your local computer store

**Name:** **Spelltest**  
**System:** Any 6809 system running FLEX or OS-9 operating system  
**Memory:** 32K to 56K total RAM (including the 8K used by operating system)  
**Language:** 6809 machine code  
**Hardware:** SWTPC, GIMIX, or any other 6809 system. Two disk drives recommended

**Description:** Menu driven spelling checker. User friendly, designed to be used by a secretary. *Spelltest* is interactive, letting you check each word in context. It writes a corrected file for you after checking. Also allows you to build an additional dictionary of new words. You may accept, accept and save, or replace each suspect word. Suspected misspelled words may be listed on terminal or printer, checked individually or checked in context. Also will print list of valid words. Fast operation. 22,000+ dictionary.

**Price:** \$199.95  
 Includes 22,000 word dictionary and binary code and instructions. Source \$100 additional.  
**Author:** Dale L. Puckett  
**Available:**  
 Frank Hogg Laboratory  
 130 East Water  
 Syracuse, NY 13210  
 (315) 474-7856  
 Master Card and VISA accepted

**Name:** **W7AAY RAE to BASIC File Transfer Program**  
**System:** Syntertek SYM-1  
**Memory:** 8K minimum  
**Language:** BAS-1 and RAE-1  
**Description:** This 512-byte ROMable program allows RAE text files to be transferred to BASIC and for BASIC programs to be transferred to RAE. Now you can use the powerful RAE editor to create and modify BASIC programs. Fully documented source code in RAE format supplied on cassette tape with instructions.  
**Price:** \$15.00 ppd. in USA  
 \$17.00 foreign  
**Author:** John M. Blalock  
**Available:**  
 Blalock and Associates  
 P.O. Box 39356  
 Phoenix, AZ 85069

**Name:** **Entertainment Software for Ohio Scientific**  
**System:** OSI C2-4P or C4P micros

**Memory:** 8K  
**Language:** BASIC  
**Hardware:** Cassette, 5 1/4" disk, or 8" disk  
**Description:** Micronics Computerware is introducing a line of software beginning with the following full feature games: *Breakout*, *Box-In Hangman*, *Crossball*, and *Battleship*. All the games take full advantage of OSI's sound, color and graphics features. Interested parties should write or phone for complete information.  
**Price:** \$6.95 (cassette)  
 \$9.95 (disk) - write for more information on disks.  
 Includes cassette or disk, full documentation

**Available:**  
 Micronics Computerware  
 750 Auburn Avenue  
 Buffalo, NY 14222

**Name:** **DOW2000 & Option43**

**System:** Apple II  
**Memory:** 48K  
**Language:** Applesoft  
**Hardware:** Disk 3.3/3.2 and printer option  
**Description:** Stock Market Analysis will determine price projections based on a stock's BETA coefficient or Relative Strength # and the Dow Jones Average. Projections are made as you vary the DOW (What if...); on one stock or entire portfolio with single scan, quick scan, or variable scan of values. The option program will give you the percent of increase of the option months to determine which month and strike price option to buy for a given stock. Included is the booklet "The Art of Timing Your Stock's Next Move."

Author in market 17 years and former Registered Investment Advisor with S.E.C.

**Price:** \$29.95  
 Includes booklet (booklet alone \$5.95)  
**Author:** CIAC: Patrick and David Calabrese  
**Available:**  
 Bit 'n Pieces Series  
 P.O. Box 7035  
 Erie, PA 16510

(Continued on next page)

## Software Catalog (continued)

<p>Name: <b>FORTH Programming Aids</b>          System: fig-FORTH model [FORTH-79 in preparation]          Memory: free dictionary space: 3K minimum, 13K recommended          Language: High level FORTH          Hardware: Any with the above FORTH systems</p> <p>Description: These routines aid in development and debugging and complement cross/meta compilers with commands to perform the following: (1) decompose words into structured FORTH code (it generates IF, ELSE, etc.), optionally to disk; (2) find (and decompile) all words called by a specified word; (3) find all calls to a specified word; (4) create a one-to-one translation of FORTH run-time code.</p> <p>Price: \$150.00 (California residents add 6.6%. Foreign air add \$15.)          Includes 40-page manual and all source code</p> <p>Author: T.E. Wempe, R.E. Curry</p> <p>Available:          Curry Associates          P.O. Box 11324          Palo Alto, CA 94306</p>	<p>Name: <b>Fun With Math Vol. 1</b>          System: Apple II, Apple II Plus          Memory: 48K with DOS 3.3 and FP in ROM          Language: Applesoft and Integer (RAM Integer on disk)          Hardware: Apple II or Apple II Plus computer, DOS 3.3, game controllers not required.</p> <p>Description: Educational programs present drill in the four basic operations in a highly motivational game format using the Apple's graphics and sound capabilities. All programs offer immediate reinforcement and have two levels of difficulty, which is under teacher control. These programs are designed to be "childproof" and are almost impossible to "crash." The programs were written by a teacher who has had 17 years classroom experience. Three games (Bomber, Saucer Math and Lone Ranger Fast Draw) furnish drill in the four basic operations. The other programs (Anti-Aircraft, Sub Commander, Fraction Gunfight, Place Value Tank, and Talking Subtraction) provide drill in place value, equivalents in measurement, fraction identification, and subtraction with regrouping.</p> <p>Price: \$44.95          Additional copies \$15.00 ea.          \$19.95 for Bomber, Saucer Math and Lone Ranger Fast Draw only</p> <p>Author: M.C. Henderson III</p> <p>Available:          Learn-A-Lot Software          711 Ahrens          Houston, TX 77017          (713) 643-2064</p>	<p>Name: <b>librarian/programmer and tested in several library environments. Other library software available.</b>          Price: \$250.00 in U.S.          Includes manual          Author: Bob Stevens          Available:          Richmond Micro Software          Box 94088          Richmond, B.C.          Canada V6Y 2A2</p> <p>Description: For use with the Pascal Speedup Kit, <i>Spooler</i> allows the user to continue using the entire Pascal system while producing printed reports. Key features: works in any slot with any printer and virtually any printer interface card; automatically picks up user's workflow.</p> <p>Price: \$45.00</p> <p>Available:          Stellation Two          P.O. Box 2342          Santa Barbara, CA 93120          (805) 966-1140</p>	<p>Name: <b>polyFORTH</b>          System: Motorola EXORset 30, EXORcisor I &amp; II, Omni-Byte 68000, Intel 8080, 8085, 8086, RCA 1802, LSI-11/02, 23, PDP 11/20-11/70, IBM Series 1, Z-80          Memory: 8K Bytes          Language: FORTH          Hardware: Many disk subsystems, printers, specialized control hardware, etc.</p> <p>Description: <i>polyFORTH</i> from FORTH, Inc. is a multi-tasking, multi-programming environment which includes editor, file handling, virtual memory, language and utilities. It is widely used as a total approach to professional systems development by software and hardware engineers, product designers, educators and scientists. Users of this uniquely powerful technology achieve greatly reduced development time and memory size without sacrificing processor speed or flexibility. <i>polyFORTH</i> is the latest and most advanced implementation of the extensible FORTH language developed by Charles H. Moore of FORTH, Inc. in 1972.</p> <p>Price: \$5100-\$8200 depending upon configuration          Includes all features, full source and documentation.          Options include: graphics, file system, educational courses, consulting.</p> <p>Available:          FORTH, Inc.          2309 Pacific Coast Highway          Hermosa Beach, CA 90254          (213) 372-8493</p>
<p>Name: <b>Small-C for 6809</b>          System: 6809 with FLEX9 or DOS 69D (OS-9-planned)          Memory: 48K recommended          Language: C          Hardware: Any which will run above operating systems</p> <p>Description: Proper subset of C except for #ASM extension. Based originally on Small-C by Ron Cain, with a few extensions. Generates relocatable code, special loader supplied for TSC's absolute assembler. SSB users should furnish description of hardware and OS revision level. Version 1.0 now, 2.0 July.</p> <p>Price: \$52.50 (5") version 1.0          Includes source for run-time library, compiler-tester, and FLEX loader.</p> <p>Author: Allan Batteiger, Bill Knight, Howard Harkness</p> <p>Available:          Word's Worth          P.O. Box 28954          Dallas, TX 75228</p>	<p>Name: <b>Library On-Line Circulation System</b>          System: Apple II Plus          Memory: 48K          Language: Applesoft and Machine          Hardware: One or two disk drives, "Paper Tiger" printer (optional)</p> <p>Description: Uses A.B.T. barcode wand™ and barcoded labels to circulate up to 40,000 titles for 2,000+ borrowers in schools and small libraries. Produces overdue notices; handles unlimited "holds" and "reserves." Programmed by a</p> <p>Price: \$60          Includes diskette and manual.</p> <p>Available:          Mind Systems Corporation          P.O. Box 506          Northampton, MA 01061          (413) 586-6463</p>	<p>Name: <b>Transfer III</b>          System: Apple III          Memory: Standard          Language: Applesoft          Hardware: Built-in disk drive</p> <p>Description: <i>Transfer III</i> is a new and valuable utility for the Apple III computer. It moves sequential text files either way between an Apple II disk (DOS 3.3) and an Apple III. It can be used, for example, to transfer VisiCalc data files, word-processor text files, BASIC programs converted to text files, and laboratory-data files. All actions required are performed easily and automatically after you select options from menus.</p> <p>Price: \$60          Includes diskette and manual.</p> <p>Available:          Mind Systems Corporation          P.O. Box 506          Northampton, MA 01061          (413) 586-6463</p>	<p>(Continued on next page)</p>

## Software Catalog (continued)

Name: **Pegasus**  
 System: Apple II Plus (at present — CP/M, Apple III and IBM PC in future)

Memory: 64K  
 Language: Apple Pascal  
 Hardware: Two disk drives (one for program must be 5", other can be 5", 8" or a hard disk)

Description: *Pegasus* was designed to be easy to learn and use by the novice computer user, and also allow the experienced programmer to write applications programs. *Pegasus* is a general data base management program. Input of data can be from the keyboard or from disk files. Output from the system may be to the screen, printer or to disk files.

Price: \$199.95  
 Includes disk (5 1/4" format at present), manual and update service

Author: Sunil Subbakkirnna and J. David Lehman of Shakti Systems, Inc.

Available:  
 Powersoft, Inc.  
 P.O. Box 157  
 Pitman, NJ 08071  
 (609) 589-5500

XPTERM 232 work with either the TNW 232D or the TNW-2000, connected directly to the host computer or via an acoustical coupler. With the TNW 232D, BREAK can be sent from the keyboard, while the TNW-2000 requires a separate switch modification for BREAK. PTERM 232 will not support 1200 bits per second operation due to the PET scroll delay.

Price: \$19 PTERM-103  
 \$49 XPTERM-103  
 \$19 PTERM-232  
 \$49 XPTERM-232  
 \$29 PTERM-8010  
 \$59 XPTERM-8010

\$5 extra for program on 2040 or 8050 disk instead of tape. PTERM-103 free with TNW 103 modem.

Includes documentation. Updating provided free of charge for one year.

Available:  
 TNW Corporation  
 Dept. MJ  
 3444 Hancock Street  
 San Diego, CA 92110  
 (714) 296-2115  
 TWX 910-335-1194

Name: **PTERM-103**  
**PTERM-232**  
**PTERM-8010**  
**XPTERM-103**  
**XPTERM-232**  
**XPTERM-8010**

System: Commodore PET and CBM

Memory: 8K for PTERM; 32K for XPTERM

Language: Commodore BASIC and 6502 assembly language

Hardware: CBM disk for XPTERM. Serial interface on telephone modems.

Description: *PTERM-103* provides auto-dial, auto-answer capabilities. Phone numbers are stored and dialed by mnemonic. The baud rate is software selectable (110, 150 or 300 bits per second). *XPTERM-103* allows the system to automatically answer calls from other XPTERM users (103, 232 or 8010 versions). After the remote user provides a password, CBM disk files can be transferred in either direction. *PTERM 232* and

Name: **SofTech for UCSD Pascal™**

System: The UCSD p-System™

Memory: 48K runtime environment; 64K development environment

Language: UCSD Pascal  
 Hardware: 8086, Z-80, 8080, 8085, 6502, 9900, 6809, 68000, and LSI-11/PDP-11

Description: *SofTech* is a computer-aided instruction package that helps the novice learn to use and understand UCSD Pascal. *SofTech* is accompanied by *The UCSD Pascal Handbook* which provides a complete description of the concepts of structured programming embodied in the UCSD Pascal.

Price: \$125.00  
 (Prices subject to change)  
 Includes object code, SofTech User Manual, and the UCSD Pascal Handbook

Available:  
 SofTech Microsystems, Inc.  
 9494 Black Mountain Rd.  
 San Diego, CA 92126  
 (714) 578-6105

(Continued on next page)

## AIM 6809???

### UPGRADE YOUR AIM 65\* TO 6809 CPU POWER WITH "MACH-9"!

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 \*Super-set of AIM Monitor  
 \*Two-Pass Symbolic Assembler  
 \*Complete Monitor Documentation & Source

### HOBBYIST AND INDUSTRIAL VERSIONS Available Now:

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### IMMEDIATE FUTURE:

\*STC FORTH System with Virtual Disk  
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**(602) 746-0418**



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 Personal check (allow 2 weeks to clear).

**CompuTech**  
 Box 20054  
 Riverside, CA 92516

# L I S P

## for the Apple II

The gnosis version of P-LISP has been acknowledged as the finest and most complete available for Apple microcomputers, and, with the addition of floating point math and HI-RES graphics, it becomes an indispensable tool for educators: scientists, business executives, mathematicians, or applications requiring artificial intelligence. This excellent program is now available for only \$199.95 (DOS. 3.3 only).

Included in an attractive binder is a ninety page user's manual which will aid you in creating your P-LISP programs. This manual is also available separately for \$20.00, which is fully refundable on purchase of the program.

P-LISP will run on a 48K or larger APPLE II/II+, and will take advantage of ALL available memory.

Supplied with the interpreter are several sample programs including a complete ELIZA.

For those of you who do not fully understand P-LISP, we have available the P-LISP Tutorial for \$25.00. This expertly written text is bound in a handsome binder and is packaged to include a disk containing all the sample programs referenced in the text at no extra charge.

  
Applesoft in ROM or a language card is needed for floating point math



formerly Pegasys Systems, Inc.

4005 Chestnut Street—Philadelphia, PA 19104  
Orders Only: 800-523-0725—Penn. Residents: 215-387-1500

Pennsylvania residents add 6% sales tax. Apple is a trademark of Apple Computer Inc.

## 6809 Small-C

More bang, less buck! WW Small-C 1.0, with separate optimizer. Has all C control structures, including do/while, for, and switch/case. Generates relocatable modules for either TSC absolute assembler or SSB MACRO. (Version 2.0 is also planned for OS-9.) FLEX9 version includes RLOAD 3.0 on separate disk. Run-time library source included. 48K recommended.

For FLEX9 (with loader)	\$52.50
(If you already have RLOAD)	\$47.50
RLOAD 3.0 separately	\$17.50
For DOS69D (specify assembler and CPU)	\$47.50

Shipping included. Prices good until version 2.0 release (about July). Liberal upgrade policy. Add \$2/disk for 8". Add \$2 handling for Visa/MC. Allow 4 weeks for non-certified check. Please don't mail cash. Payment must accompany PO. Texas residents: add \$0.25 sales tax each 5" disk, \$0.35 each 8" disk.

DOS69D is a trademark of SSB. FLEX is a trademark of TSC. OS-9 is a trademark of Microware.

## word's worth

P.O. Box 28954  
Dallas, Texas 75228

## Software Catalog (continued)

Name: **Piper**  
System: VIC-20 and PET/CBM  
Memory: 2K  
Language: Assembly  
Hardware: Standard VIC or PET/CBM with CB2 speaker

Description: This unique program allows you to compose, save, recall and play back music using a standard VIC or a PET with a CB2 speaker. You enter music using alpha notation: A F# C D. Rests and note duration are just as easy. You may vary volume, tempo, print pictures or text and automatically load and play additional compositions from cassette or diskette.

Price: \$25  
Author: Roy Wainwright  
Available:  
Abacus Software  
P.O. Box 7211  
Grand Rapids, MI 49510  
(616) 241-5510

for all ages. All major solar system members are displayed in detail on hi-res color screens. Moon phases and planetary movement are also animated on hi-res screens. Planet satellites as well as comets and asteroids are also covered. *The Planetary Guide* is menu driven, and single key-stroke commands allow rapid access to the many general purpose or detailed programs.

Price: \$30.00  
Available:  
Synergistic Software  
5221 120th Ave. S.E.  
Bellevue, WA 98006  
(206) 226-3216

Name: **LexiCom**  
System: Apple II or Apple II Plus  
Memory: 48K  
Language: Applesoft

Description: A word processing utility that allows nearly universal transfer of word processing files. Converts Applewriter to Supertext, Supertext to Applewriter, and either of these may be converted to or created from sequential text files. Allows modem transfer of word processing files, editing of BASIC programs.

Price: \$49.95  
Includes documentation  
Author: David Szetela  
Available:  
Micro-SPARC Systems Div.  
Dept. P  
P.O. Box 325  
Lincoln, MA 01773

Name: **Memory II**  
System: C4P and C8P  
Memory: 8K  
Language: BASIC  
Hardware: Amplifier

Description: This is just like the game of *Simon Says* with four color blocks on the screen that the computer will turn on randomly. The computer will start off by lighting one color, then two, three, etc. You will have to copy what the computer plays. The longer the sequence the faster it plays. There are three options: color and sound, color only, and sound only. There are four levels of play—the higher the level the longer the sequence!

Price: \$7.95  
Includes instructions  
Author: Mark A. Dickenson  
Available:  
Compu-U-Gamer Software  
P.O. Box 802  
Nevada, MO 64772

Name: **Doctor's Office Companion™**  
System: Apple II  
Memory: 48K  
Language: Applesoft  
Description: *Doctor's Office Companion* provides office efficiency through automation of patient billing, completion of insurance forms, accounts receivable ageing, and account history tracking, freeing the doctor's office from billing drudgery and expense.

Price: \$995.00 special introductory price  
Includes program and complete documentation  
Available:  
High Technology Software Products, Inc.  
P.O. Box 14665  
2201 N.E. 63rd St.  
Oklahoma City, OK 73113

## Software Catalog (continued)

Name: **The Triangulator**  
System: Apple II Plus  
Memory: 48K  
Language: Assembly  
Hardware: Disk and Printer  
Description: Solves oblique and right triangles and saves results for use in calculation of next triangle. Up to nine results can be saved and used to solve another triangle, or printed in tabular form.  
Price: \$39.95  
Author: David P. Talich  
Available:  
Arrow Data Systems  
1224 E. Harmon  
Phoenix, AZ 85020

Name: **Property Management System (PMS)**  
Memory: 48K  
Language: CBASIC  
Hardware: Dual diskette drives (220K each), 80 x 24 screen, 80-column printer  
Description: A general ledger system that keeps track of all income (tenants') and expenses providing financial reports and management information necessary to control income properties. This software package includes a check-writer, budgeting, and exception reports like a list of delinquent tenants. All information and reports are available immediately from the system either on the screen or printed.  
Price: \$795.00  
Includes one year of maintenance  
Available:  
Realty Automation, Inc.,  
221 N. Lois  
La Habra, CA 90631  
(213) 947-2762

Name: **Outpost**  
System: OSI  
Memory: 8K  
Language: Machine Code  
Hardware: C1P/Superboard, Cassette  
Description: Take the ship movement from *Asteroids*, the swarming aliens from *In-vaders*, the rubber, bouncing ship from *Omega System*, and the constantly rotating fortress from *Star Castle*, and you're beginning to get an idea of what this high speed, original

arcade game looks like. You have to recover the lost fuel cell and bring it back into your outpost, while dodging blocks, reproducers and the ever-present aliens (up to 20 of them swarming around at once!) *Outpost* can be played by one or two players.

Price: \$11.95  
Author: Dave Edson  
Available:  
Pretzeland Software  
2005 Whittaker Rd.  
Ypsilanti, MI 48197

Name: **The Tool™**  
System: Apple II  
Memory: 48K  
Language: Applesoft  
Hardware: One disk II disk drive. Optional equipment includes one to four Corvus disk drives or up to eight disk II drives and a printer.

Description: *The Tool* is designed to save programmers 80% to 90% of development time. *The Tool* generates program code... machine language code. It provides an entry screen generator, a database manager, and a report formatter. *The Tool Operating System* (TOS) allows files to span multiple disk drives. Whether you have four 20-megabyte drives or eight floppy drives and 254 diskettes, TOS can use the storage space as one large file or several.

Price: \$395.00 special introductory price  
Includes program and complete documentation

Available:  
High Technology Software Products, Inc.  
P.O. Box 14665  
2201 N.E. 63rd Street  
Oklahoma City, OK 73113

Name: **Foosball**  
System: Apple II or Apple II Plus  
Memory: 48K  
Language: Assembly  
Hardware: One disk drive  
Description: No more dressing up and braving the elements to get your kicks in a smoky, noisy arcade. Now you and up to three of your friends can play *Foosball* at home. Divide into Grud and Robot teams and

bash the ball around the screen. Two can play with paddles or up to four can play with Sirius Software's Joyport™ and two sets of paddles.

Price: \$29.95  
Includes diskette and documentation  
Author: Keithen  
Available:  
Your local computer store

Name: **AmperSoft**  
System: Apple II or Apple II Plus  
Memory: 48K  
Language: Applesoft  
Hardware: RAM Card - 16K or 32K

Description: Provides four extensions to Applesoft: print using, machine language sort, automatic disk storage and retrieval of arrays, and automatic matrix operations. Moves DOS onto RAM card to provide 10K additional program space. All extensions accessed by simple commands within Applesoft programs.

Price: \$49.95  
Includes extensive documentation  
Author: Cornelis Bongers  
Available:  
Micro-SPARC Systems  
Division, Dept. P  
P.O. Box 325  
Lincoln, MA 01773

Name: **CommuniTree — First Edition**  
System: Apple II, Apple II Plus  
Memory: 48K  
Language: FORTH  
Hardware: Up to six disk drives; Hayes Micromodem II

Description: *CommuniTree — First Edition* is a versatile telecommunications software package that can create a wide variety of on-line computer conferencing and videotext facilities. The software makes a highly "intelligent" messaging system — its unique, tree-structured database format puts new messages directly and immediately where they belong. (No lengthy, time-consuming sorts to organize your information after the fact!) By connecting the computer with the telephone lines (via modem), the software lets many people share the information. Users of the system can call into the host computer with their own computer or terminal from remote locations. The Turing Test, seven

level password protection, and "private" section of the Conference Tree allow the host operator to choose just who uses the system. It can emulate a public bulletin-board-like system, or a private professional exchange between colleagues, or both!

Price: \$120.00  
Includes manual, program disk, data disk.

Available:  
The CommuniTree Group  
470 Castro  
Suite 207-3002  
San Francisco, CA 94114  
(415) 474-0933

Name: **Print Spooler**  
System: The UCSD p-System™  
Memory: 48K runtime environment; 64K development environment

Language: Written in UCSD Pascal™  
Hardware: 8086, 8080, 8085, Z80, 68000

Description: *The Print Spooler* is a user-executable program which sends one or more text files to a printer while the user continues normal UCSD p-System operations, such as text editing or data entry.

Price: \$50.00  
(subject to change)  
Includes object code for the *Print Spooler*.

Available:  
SoftTech Microsystems, Inc.  
9494 Black Mountain Rd.  
San Diego, CA 92126  
(714) 578-6105

Name: **Capitalization Order #0339AD-C10**  
System: Apple II or Apple II Plus

Memory: 32K  
Language: BASIC  
Description: *Capitalization* is designed for students, writers, reporters — anyone who wants to learn or review the relevant laws quickly and effectively. Each of the 12 fundamental rules is concisely explained on the screen, then examples are given, followed by exercises. The computer keeps score and reports the level of mastery at the end of each set of exercises.

Price: \$24.95  
Author: Charles Barnes, Robert Large  
Available:  
Instant Software  
Peterborough, NH

**MICRO**™

## Resource Update

(Continued from page 100)

### Softalk

\$18.00 per year, 12 issues  
Softalk Publishing, Inc.  
11201 Magnolia Blvd.  
North Hollywood, CA 91601

### Stems From Apple

\$9.00 per year, 11 issues  
\$2.00 application fee  
Apple Portland Program  
Library Exchange  
c/o Dick Stein  
P.O. Box 1608  
Beaverton, OR 97075

### T.A.R.T.

\$15.00 per year, quarterly  
The Apple Resource Team  
c/o Sid Koerin, Editor  
1706 Hanover Ave.  
Richmond, VA 23220

### User Magazine

DM 50,-  
Apple User Group Europe e.V.  
Hackstuekstr. 11  
D-4320 Hattingen 15  
West Germany  
(Printed in German)

### Washington Apple Pi

\$18.00 per year, 12 issues  
P.O. Box 34511  
Bethesda, MD 20817

### AIM-RELATED

#### Interactive

\$5.00 for 6 issues  
Newsletter Editor  
Rockwell International  
P.O. Box 3669, RC55  
Anaheim, CA 92803

#### The Target

\$6.00 per year, 6 issues  
Donald Clem, Editor  
RR#2  
Spencerville, OH 45887

### ATARI-RELATED

#### A.N.A.L.O.G. Magazine

\$10.00 per year, 6 issues  
P.O. Box 23  
Worcester, MA 01603

#### Atari Computer Enthusiasts

\$10.00 per year, 10 issues  
c/o M.R. Dunn  
3662 Vine Maple Dr.  
Eugene, OR 97405

#### The Atari Connection

\$10.00 per year, quarterly  
Atari Incorporated  
1265 Borregas Ave.  
P.O. Box 427  
Sunnyvale, CA 94086

### Iridis

The Code Works  
Box 550  
5578 Hollister, Suite B  
Goleta, CA 93017

### OSI-RELATED

#### The Aardvark Journal

\$9.00 per year, 6 issues  
Aardvark Technical Services, Ltd.  
2352 S. Commerce  
Walled Lake, MI 48088

#### OSIO Newsletter

\$15.00 per year  
c/o Rick Myers  
12004 Partillo Rd.  
Bowie, MD 20715

#### OSI Users Group

c/o Richard Ellen  
12 Bennerley Rd.  
London SW11  
England

#### OSI User's Independent Newsletter

\$10.00 per year, 6 issues  
c/o Charles Curley  
405 E. 3rd St. #123  
Long Beach, CA 90802

#### Peek(65)

\$15.00 per year, 12 issues  
P.O. Box 347  
Owings Mills, MD 21117

### PET-RELATED

#### Commodore Magazine

\$15.00 per year, 6 issues  
Commodore Business Machines, Inc.  
681 Moore Road  
King of Prussia, PA 19406

#### Commodore PET Users Club

Newsletter  
£ 10.00, 5-8 issues, £ 15.00 overseas  
Commodore Information Centre  
360 Euston Rd.  
London NW1  
England

#### Nieuwegein PET Users Group

Nijpelsplantsoen 252  
3431 SR Nieuwegein  
The Netherlands  
Attn: Hans Tammer or Louis Konings

#### The Paper

\$20.00 per year, 6 issues  
c/o Centerbrook Software Designs  
Pearl Street  
Livingston Manor, NY 12758

#### Microcomputer Printout

\$29.00 (air) per year, 12 issues  
Stuart House, Perrymount Rd.  
Haywards Heath, West Sussex, U.K.

#### 73 Magazine

\$25.00 per year, 12 issues  
P.O. Box 931  
Farmingdale, NY 11737

PET Benelux Exchange  
\$35.00 per year, quarterly (in Dutch)  
Copytronics  
Burg, Van Suchtelstraat 46  
7413 XP Deventer  
The Netherlands

### The Transactor

\$15.00 (Canada) per year, (6-8 issues)  
Commodore Systems  
3370 Pharmacy Ave.  
Aigincourt, Ontario M1W 2K4  
Canada

### VIC Computing

\$20.00 per year  
Paradox Group  
39-41 North Road  
London N7 9DP,  
England

### SYM-RELATED

#### Sym-Physis

\$10.00 per year, quarterly  
\$13.50 per year, overseas  
Sym-1 Users' Group  
P.O. Box 315  
Chico, CA 95927

### TANDY RELATED

#### The Rainbow

\$12.00 per year  
5803 Timber Ridge Dr.  
Prospect, KY 40059

#### TRS-80 Microcomputer News

\$12.00 per year, 12 issues  
Tandy Corporation  
P.O. Box 2910  
Forth Worth, TX 76113

#### 80 Microcomputing

\$25.00 per year, 12 issues  
1001001 inc.  
80 Pine Street  
Peterborough, NH 03458

### NON-COMPUTER MAGAZINES

#### EDN (Electronic Design News)

\$25.00 per year, 22 issues  
Cahners Publishing Co.  
270 St. Paul Street  
Denver, CO 80206

#### Popular Electronics

\$15.00 per year, 12 issues  
One Park Ave.  
New York, NY 10016

#### QST

\$25.00 per year, 12 issues  
American Radio Relay League  
225 Main Street  
Newington, CT 06111

#### Radio-Electronics

\$13.00 per year, 12 issues  
200 Park Ave., South  
New York, NY 10003

**MICRO**



## MICRO Hardware Catalog

### 16K/32K RAM board

System: Atari 400/800

Description: Part #H216, the Mosaic 16/32K RAM, adds 16K to an Atari computer system. Upgrade to 32K is very easy using the \$60 upgrade kit #H212. Atari 400 owners can use their existing 16K RAM to upgrade to 32K for \$120. The Mosaic 16/32K RAM is of interest to owners of Atari 400 with 16K, Atari 800 with 16K or 32K.

Price: \$119.95 — #H216  
\$69.95 — #H212

Available:  
Mosaic Electronics  
P.O. Box 748  
Oregon City, OR 97045

### 8-Bit, 8-Channel A/D system

System: Apple

Language: All

Hardware: Any Apple

Description: The Applied Engineering A/D board is an 8-bit, 8-channel, memory-buffered data acquisition system. Features: 8-bit resolution, on-board memory, fast conversion (.078 ms), A/D process *totally transparent* to Apple (looks like memory).

Price: \$129.00  
Includes PC board and manual

Available:  
Applied Engineering

### Inductive Coupled Originate/Answer Modem

System: General Purpose  
Description: Inductive-coupled modem eliminates room noise, vibration caused by acoustic coupling. 0.300 baud, Bell 103-compatible. Originate/Answer, half/full duplex, RS-232, TTL, CMOS-compatible. Cassette tape ports save data. 110V AC or 9U batteries. Crystal controlled.

Price: \$129.95

Available:  
MFJ Enterprises, Inc.  
921 A Louisville Rd,  
Starkville, MS 39759

### Communications Cables

System: All

Description: Full line of RS-232 and RS-422/423 cables, adapters, interconnects for terminal, printer, and modem usage. RS-232 cables to custom lengths, switching boxes, parallel cables upon request. Disk data and power cables.

Available:  
Interface Technology of Maryland  
P.O. Box 745  
College Park, MD 20740  
(301) 490-3608

### PKASOTM Interface

System: Apple II, Apple III, and Printers (see below)

Memory: No restrictions  
Language: All popular languages including Pascal and CP/M

Hardware: Epson MX-70, MX-80 [Grafrax], MX-100, IDS 560/Prism, Centronics 739, Okidata Microline 80, 82, 83, 82A, 83A

Description: Complete interface between Apple and popular matrix printers. Has built-in firmware for snapshot print of any screen image — graphics or text. When used with a word processor, *Pkaso* adds software-definable symbols for subscripts or math notation, and allows graphics within the text. A gray-scale-processor directly prints computer photography. *Pkaso* commands furnish a simple hardware-independent printer control language.

Price: \$165 (U.S. list price)  
Includes interface card, cable, demonstration diskette, manual

Available:  
Apple Dealers or  
Interactive Structures, Inc.  
P.O. Box 404  
Bala, PA 19004  
(215) 667-1713

### Microsette

Description: Diskettes, cassettes for 6502 micros. Diskettes are certified, single-sided, soft-sectorized, 5 1/4", with reinforced hubs.

Price: 10/\$25 - diskettes  
10/\$7.50 - cassettes (C10)  
Includes UPS shipping in continental USA.

Available:  
Microsette Co.  
475 Ellis St.  
Mountain View, CA 94043

### Single Board Computer — GMS 6506/26/27

System: 6500/6800/Z80

Memory: 4K bytes RAM, 16K bytes ROM

Hardware: 6" x 9.75" board, EXORciser, System 65-compatible

Description: Single board computers offering interchangeable 6502, 6809, Z80 CPUs, ACIA, IEEE-488, printer ports. Eight I/O lines, two 16-bit timers, two 8-bit shift registers. VUA/VKA, bootstrapping, power on reset, reset, base address and enable/disable switches. GMS 6506 uses 6502 CPU; GMS 6526 uses 6809 CPU, GMS 6527 uses Z80 CPU.

Price: \$489  
Includes GMS 6506, 6502 CPU, 1 MHz, one-year warranty

Available:  
General Micro Systems  
1320 Chaffey Ct.  
Ontario, Canada N1K 7E2

### uCortexTM/65

System: 6502 single board computer/controller

Memory: 1K RAM, socket for 2K EPROM (2716) or 4K EPROM (TMS2532 or equivalent)

Language: 6502  
Description: 6502 8-bit microprocessor, 16 I/O lines, TTL-compatible, each line independently programmable as input or output, 4 auxiliary con-

trol lines, 2 x 16-bit timer/counter, 2K or 4K EPROM single jumper selectable, onboard 555 power-on reset circuit or external reset signal, non-maskable interrupt control on connector pin, crystal-controlled clock for precise timing applications, pinout-compatible with AIM 65 application connector, timing loops compatible with AIM 65, develop and test program on AIM 65, then transfer EPROM to uCortexTM/65.

Price: \$79.95  
Includes board, assembled and tested (EPROM not included).

Available:  
Cortex Research Corporation  
1912 Raymond Drive  
Northbrook, IL 60062  
(312) 480-1088

### Video-Printer Stand

System: For use with TRS-80 Color Computer, Videotex, Atari 400, 800, Apple II or III, and others. Most small to medium sized printers, MX-80, MX-100, etc.

Description: Place a TV (or printer) on the Video-Printer Stand and the keyboard (or fan-fold paper, disk drives, etc.) slides right under. Desk top work space is increased, the screen is raised to eye level, all components are within easy reach, and the keyboard distance from the monitor can be adjusted as desired. The Video-Printer Stand's sturdy metal construction will easily support any portable color TV. Dim.: 19 1/4" x 12" x 6 3/4".

Price: \$39.95  
Includes choice of black or beige.

Available:  
Advanced Effort-Saver Products, Inc.  
P.O. Box 5001  
Hialeah, FL 33014  
(305) 821-9961

(Continued on next page)

## Hardware Catalog (continued)

### Name: **Datalok**

System: Apple II

Memory: 48K RAM

Language: Applesoft

Hardware: One disk drive,  
DOS 3.2 or 3.3

Description: *Datalok* provides two basic utilities for the user: the ability to encrypt and decrypt any file created under Apple DOS — i.e., text, integer, binary, Applesoft, etc.; and the ability to lock and unlock an entire disk — i.e., render a disk inaccessible and unbootable to an unauthorized user. Provided also is a diagnostic program enabling the user to verify the system's operation while providing expertise on DES for the inexperienced user.

Price: \$349.00

#### Available:

Atlantis Computers  
31-14 Broadway  
Astoria, NY 11106  
(212) 728-6700

### Name: **Disk Head Controller (DMC)**

System: OSI Mini-floppy,  
C1 or C2 or C4

Hardware: Single PCB

Description: This loads and unloads the head, and turns off the drive motor after five seconds (from the last disk access). No tracks to cut; simply unplug your disk connector and connect to the DMC, then plug the DMB connector to your disk drive.

Price: \$19-\$95 — bare PCB  
\$69-\$95 — fully assembled  
and tested

Includes PCB, plus full  
instructions, one year  
warranty (assembled and  
tested version).

Available:  
G. Cohen  
72 Spofforth St.,  
Holt, Act, 2615  
Australia

### Name: **Adventure: C1 Sound**

System: OSI C1P Series 1  
(without sound)

Description: An inexpensive (and entertaining) data sheet giving simple instructions for adding the components for sound that OSI left out. Cost of the parts is about \$1.00, available at any electronics store. For both Superboard II

and C1P. Sound adds an unbelievable dimension to your computer. You'll never play another silent game once you've heard it.

Price: \$2.75

[Free with purchase of two  
Pretzelland sound games!]

#### Available:

Pretzelland Software  
2005 Whittaker Rd.  
Ypsilanti, MI 48197  
(313) 483-7358

### Name: **Instant ROM, ROM/EPROM Emulators**

System: Any

Hardware: ROM/EPROM  
Sockets

Description: *Instant ROM* is 2K, 4K, or 8K of CMOS memory with internal battery back-up, in a standard 24-pin ROM/EPROM package. When plugged into a ROM socket, a single connecting lead enables it to be programmed like RAM, at normal system speeds. When the power is switched off the program remains. The internal lithium cell gives typically 10 years life. Uses: custom font character sets for printers and video terminals, speech synthesizer ROMs, long-term data storage in logging systems, utility programs in personal computers, etc. *Instant ROM* is available now in 2516/2716/2532/2732/2364 pinouts. Application notes are available.

Price: \$78.00 - 2K  
\$112.00 - 4K  
\$178.00 - 8K

Includes application notes,  
read/write connector with  
lead.

Available:  
LMS Electronics  
3401 Monroe Road  
Charlotte, NC 28205  
(704) 376-7805

### Name: **ADA 1600**

System: PET/CBM  
Computers

Language: BASIC

Hardware: Printer adapter

Description: The *ADA 1600* allows PET/CBM computers to use standard centronics-type printers. It has a two-foot cable that plugs into the PET IEEE port. Another IEEE card edge is provided for connecting disks and other peripherals. The address is switch-selectable. The switch selects upper/

lower case. A four-foot cable with a standard 36-pin centronics connector is provided.

Price: \$129.00

#### Available:

Connecticut microComputer  
36 Del Mar Dr.  
Brookfield, CT 06804  
(203) 775-4595

### Name: **PKASO Interface**

System: Apple II and Apple  
III

Language: Pascal, CP/M,  
BASIC,  
Assembler, etc.

Description: Printer interface family for the Apple II and III and Epson, Centronics, Okidata, IDS, NEC printers. Converts your system to a complete text and graphics output system. Everything is included to start printing letters using your favorite text processor program, or to start printing hi-resolution graphics exactly as you see it on the screen. No disk shuffling or program swapping is required to use.

Price: \$165.00

Includes interface, cable,  
comprehensive user manual  
and demonstration disk.

#### Available:

Any Apple Dealer  
or Factory Direct

### Name: **AIM 65 Enclosure and Power Supply**

System: Rockwell AIM 65

Description: Brown, textured ABS plastic with an aluminum base. Case comes with power supply mounting brackets as well as circuit breaker and line cord. Optional power supply provides +5 V at 3 amps and +24 V at 0.5 amps.

Price: \$165.00 w/p.s., Model  
A65-006  
\$95.00 w/o p.s., Model  
A65-002

Available:  
Hamilton-Avnet  
and all franchised AIM 65  
dealers

### Name: **Chieftain 5 1/4" Winchester Series of Computer Systems**

Memory: 64K RAM

Language: BASIC, COBOL,  
Pascal, FORTH,  
Assembler

Description: Smoke Signal, manufacturers of the 6809-based Chieftain™ computer systems, have announced a new addition to the existing line of 5 1/4" and 8" floppy-

based, and 8" Winchester-based systems: the new 5 1/4" Winchesters. Announced are 95W4, 95XW4, 98W15, 9W15T20. The 95W4 and 95XW4 support 360K and 4 Mbyte drives, and 750K and 4 Mbyte drives, respectively. The 98W15 provides one 8" floppy (1 Mbyte) and a 15 Mbyte 5 1/4" Winchester. The 9W15T20 has a 20 Mbyte Tape Streamer and a 15 Mbyte 5 1/4" Winchester. All systems run DOS69D and the new UNIX-like OS-9 Levels I and II multi-user, multi-tasking operating system.

Price: \$6895 - #95W4  
\$7195 - #95XW4  
\$9695 - #98W15  
\$11195 - #9W15T20

#### Available:

Smoke Signal  
31336 Via Colinas  
Westlake Village, CA 91362  
(213) 889-9340

### Name: **Color Port**

System: TRS-80 Color  
Computer

Memory: 2K of RAM or 2K  
of EPROM

Language: Any

Hardware: Plug-in Cartridge

Description: Adds powerful I/O capability to TRS-80 Color Computer. Results in a very cost-effective 6809-based control system. Adds two fully programmable 8-bit bidirectional parallel ports with full handshaking. Full interrupt capability is supported, and computer voltage and logic control lines are brought out to the standard edge connector. A socket in the cartridge allows insertion of either 2K of RAM or 2K of EPROM that allows software for the control of I/O to be stored separately from the main user memory space. Provision is made for selection of both autostart of the memory in the cartridge and synchronous reset of the cartridge and the computer.

Price: \$129.95 with full  
instructions plus optional  
2K RAM for \$19.95, 2K  
EPROM for \$12.95.

Includes hardware cartridge  
and full description and user  
manual.

Available:  
Maple Leaf Systems  
P.O. Box 2190  
Station C  
Downsview Ontario  
Canada, M2N 2S9

(Continued on next page)

## Hardware Catalog (continued)

Name: **Power Pack**  
 System: TRS-80 Color Computer

Memory: 16K  
 Language: Assembly  
 Hardware: TRS-80  
 Description: The *Power Pack* allows you access to the 6809 microprocessor inside the Color Computer, and provides additional memory for the more sophisticated programs. It is a cartridge to plug into the expansion slot that contains a powerful monitor plus 6K of RAM. Special versions of such software as the Color Editor, Color Assembler, and Color Pascal are available for the Power Pack, thus eliminating the need for 32K and allowing the monitor to be resident.

Price: \$159.95 includes cartridge, diagnostics cassette, instructions

Available:  
 Computerware  
 P.O. Box 668  
 Encinitas, CA 92024  
 (714) 436-3512

Name: **Time Machine II**  
 System: Apple II

Description: *Time Machine II* is a one-second to 99-year real time clock. A powerful 2048-byte firmware driver adds many user-friendly options, including READ, FORMAT, INTERRUPT, and SET commands. Included is software DOS DATE-STAMPER to date disk files, a 50-page manual, and battery backup. Optional software includes APPLE SPOOL, an interrupt-driven printer spooler. Listings are buffered in memory then spooled to the printer. Once a file is in the buffer, other programs can be executed.

Price: \$139.00 retail  
 APPLE SPOOL \$19.95  
 [optional]

Available:  
 Creative Software Dev.  
 4657 Thayn Drive  
 West Valley City, UT 84120

Name: **VDISK™**  
 System: 6809 with FLEX™  
 Memory: 56K Plus  
 Language: Machine Language  
 Hardware: 6809 with extended addressing

Description: *VDISK* allows FLEX users to treat extended memory as a super-fast disk drive. This "virtual" disk drive has its own directory and may contain program and data files. Files may be copied to it and from it. All FLEX utilities and user programs may read from and write to this drive, just as with any other drive. The virtual disk operates much faster than a physical disk, however. The speed advantage apparent to the user will depend on the amount and nature of disk operations being carried out. The time required to load a binary file is negligible.

Price: \$99  
 Author: James Arbuckle  
 Available:  
 For dealer list contact:  
 James Arbuckle  
 P.O. Box 328  
 Ambler, PA 19002  
 (215) 643-0788

Name: **Micromodule™**  
 17 Monoboard  
 Microcomputer  
 System: Any EXORbus™-based system (M68MM17)  
 Memory: Up to 40K bytes ROM, RAM, or EPROM  
 Software: Supported by SUPERbug™ debug monitor and RMS09 executive

Description: This module contains the MC6809 MPU, five sockets for program memory or static RAM, PIA with buffered interface, two ACIAs with RS-323C interface and a triple programmable counter timer (PTM). Operates at 1 MHz.

Price: \$495.00 (1 to 5 quantities) includes user's guide

Available:  
 Motorola Semiconductor Products, Inc.,  
 Atten: Microsystems Marketing  
 P.O. Box 20912  
 Phoenix, AZ 85036  
 (602) 244-5714  
 or Motorola Sales Offices

**MICRO**

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**MACHINE LANGUAGE SPEED WHERE IT COUNTS...**

**IN YOUR PROGRAM!**

Some routines on this disk are:

Binary file info  
 Delete array  
 Disassemble memory  
 Dump variables  
 Find substring  
 Get 2-byte values  
 Gosub to variable  
 Goto to variable  
 Hex memory dump  
 Input anything  
 Move memory  
 Multiple poke decimal  
 Multiple poke hex  
 Print w/o word break  
 Restore special data  
 Speed up Applesoft  
 Speed restore  
 Store 2-byte values  
 Swap variables

For the first time, Amper-Magic makes it easy for people who don't know machine language to use its power! Now you can attach slick, finished machine language routines to your Applesoft programs in seconds! And interface them by name, not by address!

You simply give each routine a name of your choice, perform the append procedure once at about 15 seconds per routine, and the machine language becomes a permanent part of your BASIC program. (Of course, you can remove it if you want to.)

Up to 255 relocatable machine language routines can be attached to a BASIC program and then called by name. We supply some 20 routines on this disk. More can be entered from magazines. And more library disks are in the works.

These routines and more can be attached and accessed easily. For example, to allow the typing of commas and colons in a response (not normally allowed in Applesoft), you just attach the Input Anything routine and put this line in your program:

xxx PRINT "PLEASE ENTER THE DATE. "; : & INPUT,DATE\$

**&-MAGIC makes it Easy to be Fast & Flexible!**

**PRICE: \$75**

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 Applesoft is a trademark of Apple Computer, Inc.

**Anthro - Digital Software**  
 P.O. Box 1385  
 Pittsfield, MA 01202

The People - Computers Connection

## 6502 Bibliography

### 1. **MICRO** No. 44 (January, 1982)

Smith, Wayne D., "Some Help for KIM," pg. 69-72.

Hardware and software for an improved single-step function. Also included is a trace function. Switch-selectable K areas can be provided that will allow the use of a single-step program stored in any of the several K areas of the KIM micro.

### 2. **POKE-Apple** 3, No. 12 (January, 1982)

Garvey, Michael, "Storing and Reading an Array on Disk," pg. 23-25.

The time to write or read a "binary" file is significantly less than it takes for a "text" file. Here's how to save numeric arrays on the Apple.

### 3. **POKE-Apple** 3, No. 12 (January, 1982)

Haluza, Doug, "Adding Commands to BASIC with CHRGET," pg. 37-40.

An explanation of the PET command called CHRGET and how to use it. An example utility is given.

### 4. **Creative Computing** 8, No. 1 (January, 1982)

Ahl, David H. and Lubar, David, "Computer/Videodisk Coupling."

The combination of a videodisk player with a microcomputer affords a novel new area of instructional programs, games, etc. Equipment for implementing an Apple with a Pioneer VP-1000 videodisk player is described. A typical game listing and an explanation of its use is given.

### 5. **Creative Computing** 8, No. 1 (January, 1982)

Cook, Willis, "Disk Copying with A Single Eight-Inch Drive," pg. 4-6.

Listing of a program for OSI micros C2-4P or C4P to copy without the benefit of two drives. By filling available RAM memory with as much data from a disk as the memory will hold and then dumping to a swapped target disk, a full 73-track disk can be copied in twelve swaps.

### 6. **Mini'App'Les** 5, No. 1 (January, 1982)

Buchler, Dan, "Apple Plus 68000 equals DTACK Grounded," pg. 8-9.

Interfacing the Apple with the 68000 microprocessor gives your micro the capabilities of a next generation 16-bit system. Speed improvements of 6 to 13 times are claimed.

### 7. **Atari Computer Enthusiasts** (January, 1982)

Chastain, Ed, "Savmov: Disassembly of Cartridge Programs," pg. 4, 10.

A program for the Atari user interested in assembly-language programming. Two utilities named Saver and Mover to use in examining Atari cartridges. Saver creates a cassette-bootable tape, and Mover is used to relocate the cartridge program in RAM.

### 8. **Compute!** 4, No. 1, Issue 20 (January, 1982)

Butterfield, Jim, "TINYMON1: A Simple Monitor for the VIC," pg. 176-179.

A tape-loadable monitor for the VIC color computer, honoring all commands of the built-in monitors on other CBM systems.

### 9. **The Transactor** 3, Issue No. 4 (January, 1982)

Hook, David A. and Ontario, Barrie, "Word Count 9," pg. 28-36.

A utility for PET/CBM systems to count the number of words in a word processor file. For a WordPro file with 2200 words, a conventional BASIC program might require 21 minutes to count the file, while the machine-language routine here counted the same file in 13 seconds.

### 10. **Dr. Dobb's Journal** 7, Issue 1, Number 63 (January, 1982)

Fusina, Luca and Granuzzo, Claudio, "Interfacing the 68000 to an AIM 65," pg. 12-17, 36-38.

Hardware and software to interface the 16-bit 68000 to the AIM 65.

**MICRO**™

# Number Conversion

Micro Data Sheet #5

## Least Significant Digit

HEX	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
2	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
3	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
4	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
5	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
6	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111
7	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127
8	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143
9	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159
A	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175
B	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191
C	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207
D	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223
E	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239
F	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255

X =	X00	X000
Ø	0	0
1	256	4096
2	512	8192
3	768	12288
4	1024	16384
5	1280	20480
6	1536	24576
7	1792	28672
8	2048	32768
9	2304	36864
A	2560	40960
B	2816	45056
C	3072	49152
D	3328	53248
E	3584	57344
F	3840	61440

Binary	Hexadecimal	Decimal
0000	0	Ø
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8
1001	9	9
1010	A	10
1011	B	11
1100	C	12
1101	D	13
1110	E	14
1111	F	15

# Number Conversion

## BASIC Hex to Decimal

```

10 REM DELETE 70 & 80 FOR PET & OSI
15 REM AND ENTER 90 AS: Z=Z*16+Y-48+7*(Y>57)
20 REM X$ < =FFFF
30 INPUT X$
40 Z=0
50 FOR J=1 TO 4
60 Y=ASC(MID$(X$,J,1))
70 IF Y>57 THEN YY=-1
80 IF Y<=57 THEN YY=0
90 Z=Z*16+Y-48+7*YY
100 NEXT J
110 PRINT Z

```

## BASIC Decimal to Hex

```

10 REM X < 65536
20 INPUT X
30 X=X/4096
40 FOR J=1 TO 4
50 IF X>9 THEN PRINT CHR$(X+55);
60 IF X<=9 THEN PRINT CHR$(X+48);
70 X=(X-INT(X))*16
80 NEXT J

```

## ASCII Character Codes

Bits 5, 6, 7

Bits 0, 1, 2, 3

HEX BITS	0 000	1 001	2 010	3 011	4 100	5 101	6 110	7 111
0 0 0 0	NUL	DLE	SPACE	0	@	P	\	p
1 0 0 1	SOH	DC1	!	1	A	Q	a	q
2 0 0 1 0	STX	DC2	"	2	B	R	b	r
3 0 0 1 1	ETX	DC3	#	3	C	S	c	s
4 0 1 0 0	EOT	DC4	\$	4	D	T	d	t
5 0 1 0 1	ENQ	NAK	%	5	E	U	e	u
6 0 1 1 0	ACK	SYN	&	6	F	V	f	v
7 0 1 1 1	BEL	ETB	'	7	G	W	g	w
8 1 0 0 0	BS	CAN	(	8	H	X	h	x
9 1 0 0 1	HT	EM	)	9	I	Y	i	y
A 1 0 1 0	LF	SUB	*	:	J	Z	j	z
B 1 0 1 1	VT	ESC	+	;	K	[	k	{
C 1 1 0 0	FF	FS	,	<	L	/	l	:
D 1 1 0 1	CR	GS	-	=	M	]	m	}
E 1 1 1 0	SO	RS	.	>	N	^	n	~
F 1 1 1 1	SI	US	/	?	0	—	o	DEL

## 6809 Bibliography

Dr. William R. Dial  
438 Roslyn Avenue  
Akron, OH 44320

### 35. Popular Computing 1, No. 2 (December, 1981)

Firedrake, George and Zamora, Ramon, "My Computer Likes Me," pg. 76-80.  
A music program for the 6809-based TRS-80 Color Computer.

### 36. BYTE 7, No. 2 (February, 1982)

Barden, William, "Voice Synthesis for the Color Computer," pg. 258-286.  
A hardware and software article for users of the 6809-based TRS-80 Color Computer.  
Dubner, Joseph L., "6809 Machine-Code Disassembler," pg. 340-364.  
A small and fast disassembler, both reentrant and relocatable, allowing it to be placed anywhere in RAM or ROM.

### 37. CSRA Computer Club Newsletter (February, 1982)

Gresham, Jim, "Color Computer Ramblings," pg. 1.  
Start addresses in ROM of the Extended BASIC in the TRS-80 Color Computer based on the 6809 chip.

### 38. Creative Computing 8, No. 3 (March, 1982)

Linzmayer, Owen, "Chromasette Magazine," pg. 36.  
Chromasette is a monthly magazine on a 30-minute cassette containing six to eight carefully debugged programs for the TRS-80 Color Computer.

### 39. Softalk 2, No. 4 (December, 1981)

Coats, Douglas E. and Waldman, Cye H., "FORTRAN," pg. 160-172.  
In a discussion of FORTRAN for the Apple, some benchmark tests are reported which showed that FORTRAN operating with the 6809-based board, The Mill, outperformed FORTRAN with the native Apple in all respects, and also outperformed the FORTRAN80 (Softcard) in floating-point operations but not in other operations.

### 40. TRS-80 Microcomputer News 4, No. 1 (January, 1982)

Anon., "The More Serious Side of the CC," pg. 42.  
Miscellaneous notes on the TRS-80 Color Computer.  
Meyers, J.W., "Shoot-Em Again," pg. 43-44.  
A game for the TRS Color Computer.

Jamieson, John, "Core Editor," pg. 44.

A simple core editor useful for writing machine language routines and wandering around in the BASIC object code of the 6809-based TRS-80 Color Computer.

### 41. 80 Microcomputing Issue No. 27 (February, 1982)

Wood, James W., "Colorful Titrations," pg. 202-203.  
A chemical educational graphics program for the TRS-80 Color Computer.

### 42. Microcomputing 6, No. 3, Issue 63 (March, 1982)

Farnsworth, Dan, "More on the 6809," pg. 170.  
Miscellaneous notes on the 6809 including a report that a prime numbers program requiring 58 seconds on an IBM 360 or six hours, 20 minutes on a TRS-80, required only one second on a 2MHz 6809.

### 43. MICRO No. 46 (March, 1982)

Borgerson, Mark J., "A Disassembler for the 6809," pg. 89-94.  
A disassembler written in Microsoft BASIC which will run on either the Apple II (using Applesoft) or on the Radio Shack

TRS-80 Color Computer. Includes a description of the operation of the disassembler.

Barden, William, Jr., "Build A Half-year Clock for the Color Computer," pg. 100-122.  
A self-contained clock for the TRS-80 Color Computer is described in this hardware article.

### 44. 80 Microcomputing Issue No. 22 (October, 1981)

Barden, William, Jr., "The Assembly Line," pg. 42-49.  
A discussion of assembly language for the 6809 as implemented on the TRS-80 Color Computer.  
Kitsz, Dennis, "80 Applications," pg. 52-64.  
Discussion of the key addresses on the 6809-based TRS-80 Color Computer and Babybug for the Color Computer.  
Anon., "Reload 80," pg. 366.  
Some notes on programs for the TRS-80 Color Computer.

### 45. 80 Microcomputing Issue No. 23 (November, 1981)

Barden, William, Jr., "The Assembly Line," pg. 50-56.  
Machine-language routines in the 6809-based TRS-80 Color Computer.  
Kitsz, Dennis, "80 Applications," pg. 78-96.  
A discussion of TRS-80 Color Computer expansions available, including Extended Color BASIC, higher speed I/O, memory expansion, etc.  
Wood, James W., "Colorful Maneuvers," pg. 328-330.  
A game for the TRS-80 Color Computer.

### 46. 80 Microcomputing Issue No. 24 (December, 1981)

Wrye, Charles T., "Color Concentration," pg. 298-300.  
A game for the 6809-based TRS-80 Color Computer.

### 47. 80 Microcomputing Issue No. 25 (January, 1982)

Berenbon, Howard, "It's a Big, Big, Colorful World," pg. 72-73.  
Discussion of the use of the 6809-based TRS-80 Color Computer in telecommunications.  
Kitsz, Dennis, "80 Applications," pg. 342-360.  
Hardware article on replacing the keyboard on the 6809-based TRS-80 Color Computer with a TRS Model 1 keyboard.

### 48. 80 Microcomputing Issue No. 27 (March, 1982)

McClenahan, Shawn A., "Where There's A Will...," pg. 84-86.  
Hardware and procedure to allow the TRS-80 Color Computer to print while hooked into a telecommunications system.  
Ledger, Anthony M., "Color Reversi," pg. 90-101.  
A fast moving version of Othello for the 6809-based TRS-80 Color Computer.  
Murphy, Brian, "Color Computer Upgrade," pg. 102-105.  
How to install additional memory on the TRS-80 Color Computer.  
Steiner, John, "Subchaser!," pg. 106-111.  
A game with color graphics for the Radio Shack Color Computer.  
Esposito, Richard, "Smarten Up, Color Computer," pg. 126-128.  
Installing an extra 16K of RAM in the TRS Color Computer.  
Green, Roy, "Is A Rose In Color Still A Rose?!", pg. 142-150.  
Translation of TRS-80 programs for the Color Computer.  
McClenahan, Shawn A., "RAM Wars," pg. 156-161.  
Hardware article to install 64K of RAM in the TRS-80 Color Computer.

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1. Clear it to add; set it to subtract (6502)
3. 6502 hex op code for "load accumulator, absolute"
5. Substantiate
9. ASCII zero
10. Base 8
11. Opposite of last
13. Manufacturer of Color Computer
15. Branch on result not zero (6502)
16. Increment accumulator A (6809)
17. Manufacturer of 68000 microprocessor
20. Metal used in galvanizing
21. Transfer accumulator to X register (6502)
22. Base 10
25. FOR I = 1 -- 10
26. Hexadecimal E
27.  $12*15*13/(192 - 24*8)$
28. Integrated circuit
29. It marks your place on the screen
32. The easy way out
34. Something deserved by a question
36. The adjacent side divided by the hypotenuse

### DOWN

1. To put two strings together
2. Form of addressing for branch instructions
4. Goes with BASIC READ
5. BASIC function to get a number from a character
6. First step when accessing a disk
7. Affirmative
8. Turning the power on is a ---- start
12. PET stands for Personal Electronic ----
14. Goes with BASIC FOR
15. Less than a byte
18. Not imaginary
19. Twos complement of \$42
22. Important page for the 6809
23. What CLC does to the carry
24. First key to wear out
25. How the SHIFT LOCK key works
26. Countenance or 64206 in hex
30. Mnemonic for 'subtract with borrow'
31. How to get back from a machine language subroutine
33. Conditional statement
35. 238 in hex

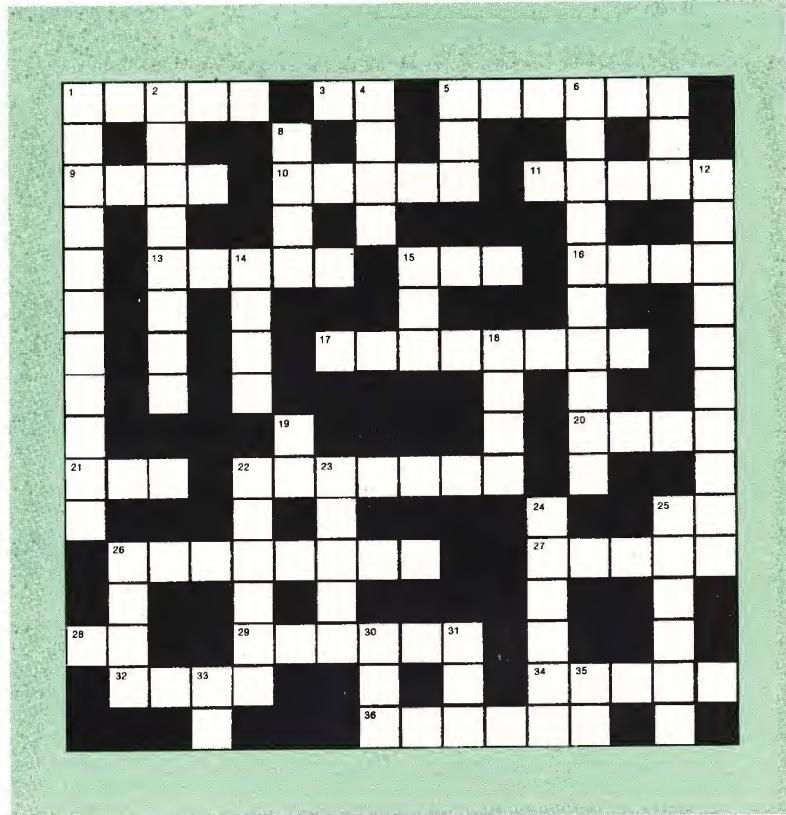
*In the 6502 puzzle in the April "It's All 1's and 0's," the second line of code should read:*

6D00 6C FF 6D START JMP (VECTOR)

*Thanks to John Krout of Arlington, VA for noticing the error.*

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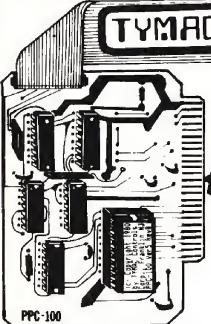
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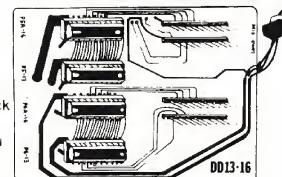
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- **Lo-Resolution Graphics for Apple Pascal** — Here's a method to access the Apple's lo-res capabilities from Apple Pascal.

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